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USSR Report

ENERGY

No. 59

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GENERAL

USSR, WORLD ENERGY DEMAND THROUGH YEAR 2100 DISCUSSED

Moscow PRIRODA in Russian No 2, Feb 81 pp 8-23

[Article by V. A. Legasov and I. I. Kuz'min: "Power Engineering Problems"]

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How can the scales of the world energy demand be evaluated for several centuries? Extrapolation is usually used for this prediction, by selecting the current rates of energy consumption growth as the original data.

World experience shows, however, that in the countries that have attained a certain level of development (social, economic and technical), the growth rates of the population and the increase in specific energy consumption are declining.

Therefore, abandoning the traditional extrapolation, we will employ the conceptual approach that is based on the following assumption : the level of energy consumption per capita and the population in the world and in individual countries will arrive at a stationary state in the final analysis.

Analytical Evaluation of Imminent Growth of Energy Consumption in the World

We will call the model of world energy consumption growth "hypothetical," since it is constructed on assumptions that, although they are substantiated, have not been strictly proved in all respects. We will evaluate the changes in the population and specific energy consumption until the moment of stabilization in accordance with the assumptions on which the hypothetical model is based, starting from the following considerations.

We will determine the changes in population in the world from the UN[1] demographic prediction that was compiled for the period to the year 2125. According to its data, the population will be stabilized by the year 2100 on the level of ~ 12 billion people. The majority of the demographers, including the Soviet, consider this prediction to be scientifically substantiated.

We will compute the growth in specific energy consumption with the help of the formula[2]:

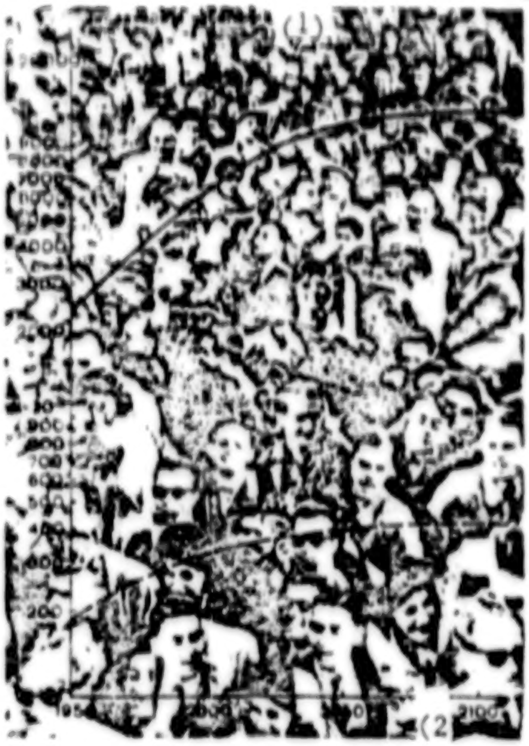
$$W_p(t) = W_{st}/1 + \exp(r - ct),$$

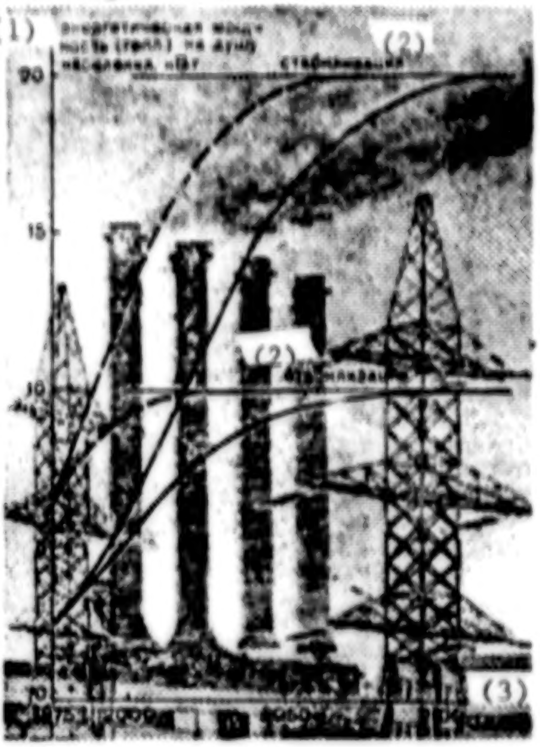
where $W_p(t)$--specific energy consumption, i.e., the annual consumption of primary (heat) energy per capita, t--time (years), W_{st}--numerical value of the stabilization level of the specific energy consumption, r and c--parameters. These parameters (r and c) are determined with the help of adjustment of the values $W_p(t)$ and by statistical data on the growth of specific energy consumption that has occurred until now.

It is important to note that the suggested method of evaluating energy demand growth is not associated with an unequivocal determination of the future (stationary) level of specific energy consumption. In this method, the quantity of the asymptotic limit of specific energy output (W_{st}) plays the role of a free parameter. Its variation permits a judgment regarding the scales of proposed energy demand and the possible sources of satisfying it for a long-term period depending on W_{st}. This takes into consideration the reserves of the examined energy sources. This is why, by using this approach, one can evaluate the effectiveness of the current energy policy, in particular, different measures to restrict or encourage the development of a certain energy source. One should stress, however, that the suggested method, like any formal approach to real processes, is important first of all from a theoretical viewpoint.

Long-term predictions of world energy consumption take into consideration two versions. In one of them, the stabilization of per capita energy demands occurs at the level of 20 kW (heat) x year per capita, while in the other it is 10 kW (heat) x year per person (see table 1).

The figure 20 kW is the sum of two terms. The first term equals 10 kW x year. This is the highest level of energy consumption per capita that is currently reached in world power engineering in the developed countries. It corresponds to the level of US power engineering development in 1975. The second term is





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Predicted Population Growth in the World (upper curve) and in the USSR

Key:

1. Population (million people)
2. Years

Predicted Growth of Energy Output (Heat) Per Capita in the World (dotted curves) and in the USSR (solid curves). Two versions of energy demand stabilization are given: 10 and 20 kW (heat) x year/per capita

Key:

1. Energy output (heat) per capita, kW
2. Stabilization
3. Years

introduced in order to take into consideration the correction for the future when the world population will significantly rise. Since the earth's resources are limited, preservation of the high living level will require additional energy per capita in order to reuse the resources, desalinate water, produce hydrogen, food products, etc. The total numerical value of this correction is evaluated at 10 kW x year per person.

Apparently, the quantity of 20 kW(heat) x year/person in calculation of the future energy demand is the highest estimate for the level of stabilization of specific energy consumption.[3]

But here one should bear in mind the following circumstance. Today's coefficient of utility of energy resources is lower than the technically attainable, while the efficiency of the power engineering units is lower than the economically optimal. Therefore, after increasing the efficiency of conversion of primary energy into

Table 1. Analytical Estimates of the Growth in World Energy Demand (in units Q) (Hypothetical Model)*

	Near phase		Middle phase				Distant phase (N--number of years that pass after the year 2100
Years	1975	2000	2020	2050	2075	2100	2100 + N
Population, billion people	3,946	6,407	8,800	11,031	11,900	12.257	12,257
Energy output (heat) per capita,** kW(heat)	1,1 2,1	4,0 4,3	5,8 6,9	8,3 11,7	9,1 15,2	9,6 17,6	10 20
Annual energy consumption (heat),** Q/year	0,25 0,25	0,76 0,82	1,5 1,8	2,6 3,9	3,2 5,4	3,5 6,4	3,6 7,3
Integral energy consumption (heat),** Q	0,25 0,25	11,7 12,1	34,2 37,5	97,9 122,3	172,2 239,2	257,1 388,6	257,1 + 3,6 · N 388,6 + 7,3 · N

Note: *1Q = 2.52 x 10^{17} kcal = 2.93 x 10^{14} kW (heat) x h = 3.35 x 10^{7} M (heat) x year

**The numbers in the top lines correspond to the version in which stabilization of energy demands occurs at the level 10 kW (heat)/person, and the bottom line corresponds to 20 kW (heat)/person.

secondary (mechanical, electrical) and after increasing the efficiency of secondary energy consumption, one can provide for the growing demand by leaving the level of primary energy production unchanged. With regard for the presented considerations, another version of the development of power engineering was examined in the framework of a hypothetical model. In this version, stabilization of the specific energy consumption occurs at the level of 10 kW (heat) x year per capita. One can assert with a great degree of realiability that the level of real stabilization will be in the examined range from 10 to 20 kW (heat) x year/person.

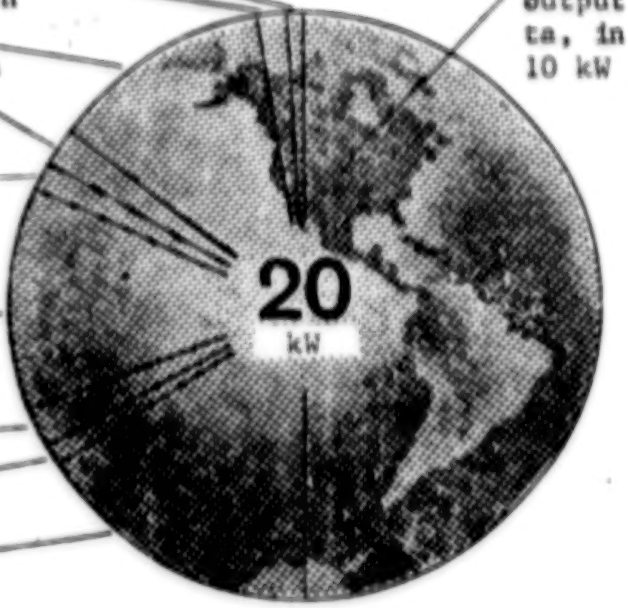
How reliable is the prediction of the development of power engineering that was obtained with the help of the hypothetical model? The special commission that was formed at the 10th World Energy Conference (MIREK-10) focused considerable attention on estimates of the future energy demand for the period to the year 2020. Comparison of these estimates with those obtained by the hypothetical model show that they are in good agreement with each other. The prediction after the year 2020 that was obtained with the help of the hypothetical model, should be viewed only as approximate for the period from 2020 to 2100. It permits a deeper study of the processes of growth in energy consumption and detection of the trend of this growth. This prediction does not have applied importance, and its task does not include obtaining practical results that are associated with planning.

Corrections for future:

0.1 kW--production of steel, aluminum, magnesium
0.5 kW--waste water and return from wastes
2.5 kW--electrolytic hydrogen
0.3 kW--air conditioning for cities
0.2 kW--intensive production of food products
2.0 kW--extraction and reuse of rare elements
0.3 kW--water desalinization (454 l per day)
0.1 kW--transporting water to cities
4.0 kW--emergency needs

10kW

extant level of energy output (heat) per capita, in United States 10 kW



Predictable Quantity of Energy Output (Per Capita) at Which Stabilization of Energy Demands Occurs (20 kW (heat) x year/person).
It is formed of the highest level of energy consumption per capita that is currently reached in the developed countries [10 kW (heat) x year/person] and corrections for the future.

It can be used for a substantiated judgment regarding the scales of energy demand proposed in this period, and the possible sources of their satisfaction with regard for the energy resource reserves.

One can apparently isolate several stages here. In the simplest case, taking into consideration the findings of the prediction for energy consumption, three phases should be distinguished in the development of the world's fuel and energy balance: near, middle and distant.

The near phase refers to the period to the year 2000, the middle from 2000 to the moment of stabilization of the energy demands, i.e., to the year 2100, and the distant phase occurs after the period of stabilization of energy demands, 2100 and further.

Three Phases in the Development of World Power Engineering

Why is the near phase in power engineering development limited precisely to the year 2000 ? The reason is that the programs to develop new energy sources have a great time lag. It is necessary to solve serious technical and social-economic tasks in order to switch to using new energy sources. This apparently requires from 15 to 20 years and determines the range of the near phase. During this phase, it is possible to build a small number of full-scale industrial units to produce energy using alternative sources. However, it is difficult to hope that before the year 2000, their percentage in the energy balance will acquire any significance.

These considerations also dictate the strategy for development of power engineering in the near phase. In the period to the year 2000, the energy demand can only be satisfied by sources whose extensive use is possible and economically justified with the extant level of development of science and technology. We note that these sources currently include power engineering based on organic fuel, hydraulic power engineering and nuclear power engineering that uses thermal neutron reactors. According to calculations using the hypothetical model (see table 1), the total energy demands in the world to the year 2000 will be about 12 Q, while the annual energy production by the end of the near phase in 2000 can reach 0.8 Q/year.[4] (For comparison we will show that in 1975 the world energy demands were 0.25 Q/year).

The time that is necessary to introduce alternative energy sources into the fuel and energy balance determines the beginning of the middle phase in the development of power engineering. From this moment, i.e., roughly from the year 2000, one will be able to accelerate the rates of construction of units to produce energy using new sources and begin their extensive use.[5] The role of alternative energy sources can be adopted by nuclear power engineering and renewable energy resources (solar energy, energy of the wind, tides, sea and ocean waves, heat of seas and oceans, and geothermal energy). During the middle phase it is necessary to optimize the fuel and energy balance. Here one should take into account the socioeconomic factors, the availability of resources of a certain energy source and their effect on the environment. According to calculations using the hypothetical model (see table 1), by the time this phase ends, the total demands (from 1975 to 2100) will be 260-390 Q of energy, and the annual will rise by 2100 to 3.5-6.4 Q/year. The middle phase must be used for a smooth and painless transition to the distant phase of power engineering development.

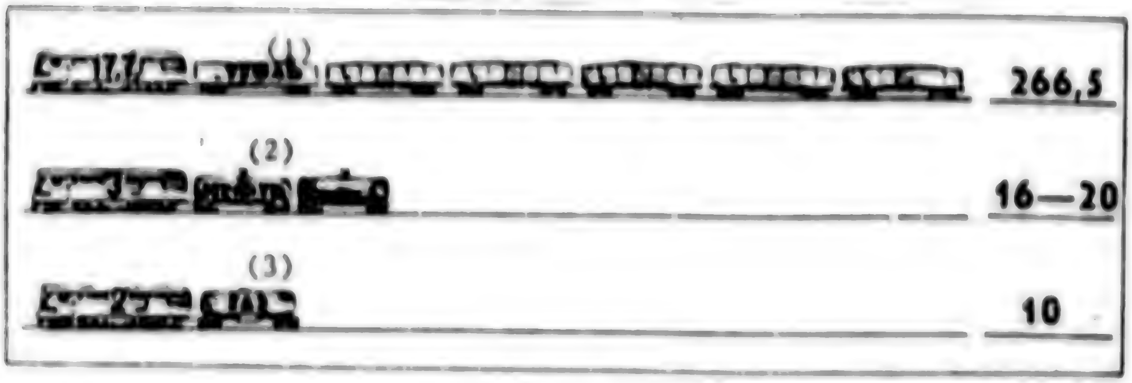
What will characterize the distant phase of power engineering development? Three main aspects can apparently be isolated here.

First of all, in this period, the actual level of stabilization of the energy output per capita will be defined. (According to the hypothetical model it is in the range from 10 to 20 kW (heat) x year/person). At the same time, permissible limits will be established for the safe effect of power engineering on the environment, social and economic factors will be considered, etc.

Secondly, thanks to the stabilization of the population, the annual energy demands of the world will be stabilized as a whole on a level that corresponds to the steady-state limits and limitations. According to the hypothetical model (see table 1), this stabilization level is limited to the range from 3.6 to 7.3 Q/year.

Thirdly, the fuel and energy balance of the world will be optimized, i.e., one or several of the few existing versions for large-scale energy supply[6] will be implemented and involved in the energy balance.

Of course, the boundaries indicated above for a certain phase are only approximate. The phases occur one after another and are not quite clearly defined. In addition,



World Reserves of Organic Fuel (in Q Units).
Black figures designate the proven fuel reserves (reliable), the colored indicate the geological reserves. The proven oil reserves (including condensate liquids) and natural gas are evaluated without consideration for the USSR. The numbers for geological reserves of oil are given with regard for the fields that will be discovered in the polar or other regions of difficult access on the continents, in the deep-sea (over 200 m deep) water areas, as well as the fields of fuel shales, bituminous sands, etc.
Key:

1. Coal
2. Oil
3. Gas

the occurrence of each phase in the development of power engineering will vary in time for different countries. It is thus quite obvious that for the technically developed countries, the distant phase will occur considerably earlier than for the world as a whole. With this stage by stage approach, the main emphasis is therefore made on the qualitative characteristics and the scales of power engineering at the given period, and not on the specific dates of occurrence of a certain phase.

We will attempt to determine the possible percentage of different energy sources in the fuel and energy balance of the world at different phase of power engineering development.

Power Engineering on Organic Fuel

The main energy source at the current stage is organic fuel. According to the UN statistical report for 1975, natural gas accounts for 19.4% of the fuel and energy balance in the world, solid fuel accounts for 30.9% and liquid for 47.2%.

Very different numbers are currently cited and discussed for the organic fuel resources. The reason for these contradictions is the simple fact that individual countries do not use the same methods for computing resources, grouping resources by categories of degree of study, possibility of extraction, etc. Today, the most substantiated are apparently the data that were obtained by the MIREK-10 experts. According to these data, the total reserves of organic fuel are estimated in the range from 22.7 Q (explored reserves) to 296.5 Q (geological reserves).[7] Over 80% is coal.

By comparing the size of these reserves with the world energy demand that is estimated by the hypothetical model (see table 1), it is easy to draw the conclusion that exhaustion of the explored reserves of organic fuel will occur long before stabilization of the fuel consumption. If one looks at the geological reserves, the organic fuel resources will be exhausted roughly by the time the energy consumption is stabilized, i.e., by the year 2100.

The following important conclusion is very obvious from here: the potentialities of power engineering on organic fuel (with regard for the proposed energy demands for the long-term period) are not great. Because of the limited resources, power engineering on the organic fuel cannot be classified as a large-scale source that is capable of producing energy of several Q per year for centuries. Its resources make it possible to cover the demands in the near phase of development and to guarantee a smooth and "painless" transition at the middle phase to alternative sources that are capable of satisfying the energy demands at an individual phase.

The limited reserves of organic fuel, especially oil and natural gas, are the main reason for the drastic reorientation of the world fuel and energy balance that is observed today.

According to the data of the MIREK-10 experts, in the beginning of the 21st century, oil and natural gas extraction will begin to drop. Their percentage in the fuel and energy balance will diminish from 66.6 to 20% by 2020.[8] These types of organic fuel will mainly be used as a raw material for the petrochemical industry, and possibly, to produce fuel for transportation.

Coal, in contrast to oil and natural gas, may maintain its position in the energy balance for a long time yet. In the year 2020, its percentage will evidently remain on today's level, equal to ~ 30%. This extensive use is explained by the existence of relatively large reserves (see table 2). However, even here there are factors that restrict the potentialities of using coal. These are the nonuniform geographical distribution of the reserves, large capital investments and time experditures to develop the new fields, as well as environmental protection problems.

It is known that thermal power plants discharge into the atmosphere such harmful substances as sulfur dioxide SO_2, nitric oxides NO_x, carbon monoxide CO and benzopyrene. The TES that operates on coal discharges almost twice as much sulfur dioxide than the TES operating on oil, and 1000 times as much as the TES that operates on gas (of course, on the condition of equal output). At the same time, sulfur dioxide belongs to one of the most harmful types of atmospheric pollution.

According to recent studies that were made on the initiative of the US National Academy of Sciences, the release of sulfur dioxide by one coal-operated TE alone with output of 1 GW (el) annually causes about 25 fatal cases, 60,000 upper respiratory passage diseases, and creates losses of 12 million dollars because of the corrosion of different materials.[7]

One should add that devices for purifying the actual fuel or exhausts of sulfur have not been introduced on a mass scale either in our country or abroad. Moreover, despite the large volume of research and development (in recent years, dozens of methods have been suggested and studied for purifying gases and fuel of sulfur), as of yet there are no inexpensive methods of controlling these emissions. Thus, substitution of coal for oil and gas in the fuel and energy balance and its extensive use will result in a considerable deterioration in the condition of the environment.

The power stations that operate on coal not only form toxic gases, but also solid wastes, mainly in the form of the finest dust particles. The developed countries today consider this finely dispersed dust to be an air pollution agent that is second in danger to sulfur dioxide. The TES 's alone produce about one-sixth of all the dust pollution that is created as a result of human activity.

It is usually thought that TES emissions are dangerous for man since they result in diseases of the heart, emphysema and chronic bronchitis. It has recently been established, however, that some of the coal combustion products can even cause cancer. Benzopyrene is thus a typical, especially carcinogenic compound that is formed in coal combustion. Of course, this is not the only substance of this type. It is therefore necessary to compute the total danger of cancer from the effect of all carcinogenic products formed during coal combustion at thermal power plants. For this purpose, data were used for England and Wales for the 1950-1959 period.[10] It was found that if coal consumption by one person rises on the average of 1 T per year, then this will increase the lung cancer death rate to 142 cases per million people per year. (We note that an increase in consumption equal to 1 T corresponds to a rise in specific energy consumption by 0.93 kW (heat) x year).

It is thus impossible to use coal as the main energy source in the near and middle phases of power engineering development. This is explained not by its limited potential reserves, but rather by considerations of technical-economic and ecological nature.

Because of these reasons, according to the estimate of the MIREK-10 experts, by the year 2020, organic fuel will be able to satisfy a little more than half of the world demand for energy resources.

The other half will have to be supplied by developing other energy sources.

Renewable Energy Sources

These include: rivers (hydroelectric power), tides, heat of the earth (geothermal energy), the sun (direct energy of solar radiation or energy of the wind, sea waves, heat of the seas and oceans).

Of the renewable resources, only hydraulic power resources are presently considered in the development of the fuel and energy balance. However, they account for an insignificant part - 1.4% of the total production of energy in the world. The world technical potential (possible use with the current state of technology, but without consideration for the economics) of hydraulic power resources corresponds to energy production equal to 0.065 Q per year. This will comprise no more than several percents in the fuel and energy balance.

Even full use of the hydraulic power resources therefore will not cover any significant part of the energy shortage that is envisaged for the beginning of the next century and that is associated with a depletion of the oil and natural gas

Table 2. World Fuel Resources of Nuclear Energy

Principle of energy production	Type of resources	Resources (in energy equivalent), Q
Thermal neutron reactors	Uranium with expenditures for extraction: up to 130 dollars/kg uranium	40
Breeder reactors	Uranium with expenditures for extraction: up to 130 dollars/kg uranium	1000
	up to 295 dollars/kg uranium	2500
	uranium in the ocean	340,000
	uranium in the earth's crust to depth of 500 m	670,000
Thermonuclear reactors	lithium (as tritium source) with expenditures for extraction up to 60 dollars/kg of natural lithium	1900
	lithium in the ocean	2,750,000
	deuterium in the ocean	4,000,000,000

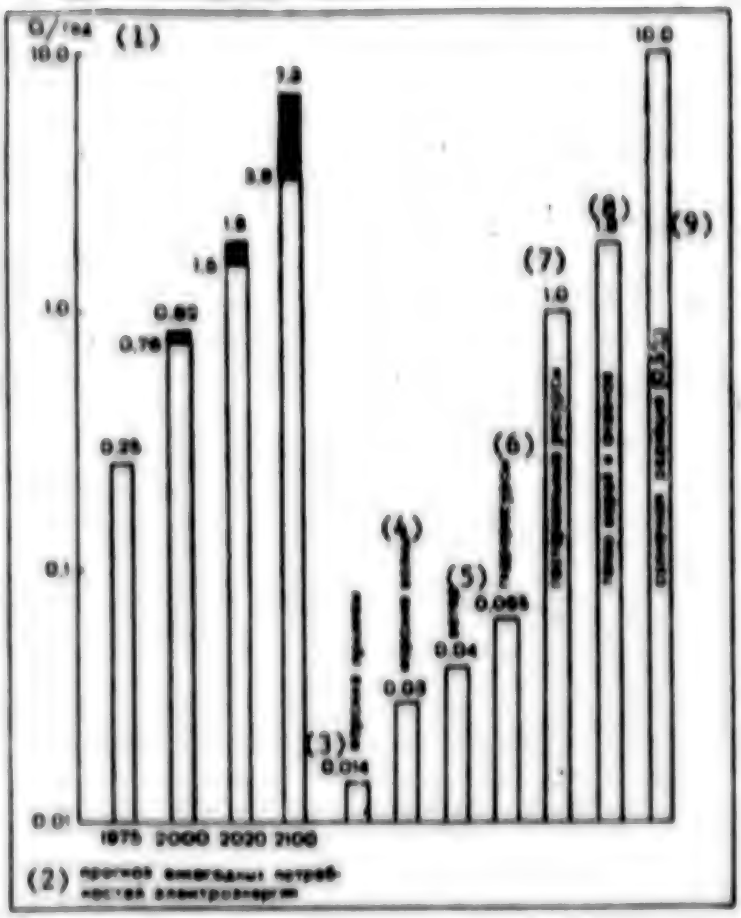
reserves. It should be added that hydraulic power significantly affects the ecological situation in the area of location of the GES. It is clear from here that hydraulic power can only play an auxiliary role in the world fuel and energy balance.

In contrast to the hydraulic power resources, all the other renewable sources today do not play any noticeable role. Not all the technical and scientific problems have been solved in their widespread use. It is only possible to use them on broad scales after the year 2000, i.e., in the middle phase of power engineering development. Accordingly, an evaluation of their potentialities should be made based on the future (after 2000) energy demands.

The technical potential of such renewable sources of energy as the energy of the wind, tides, sea waves (actually, this is accumulated solar energy) is insignificant in light of the global energy demands in the future. On the other hand, power engineering that uses the difference in temperatures of the surface and deep layers of the seas and oceans (heat of the seas and oceans),[11] and geothermal power engineering have great potentialities.

The technical potential of geothermal power engineering corresponds to the annual production of 1 Q of energy, while the use of the heat of seas and oceans to ~ 2 Q. However, these quantities of energy can hardly be used to cover the energy balance.

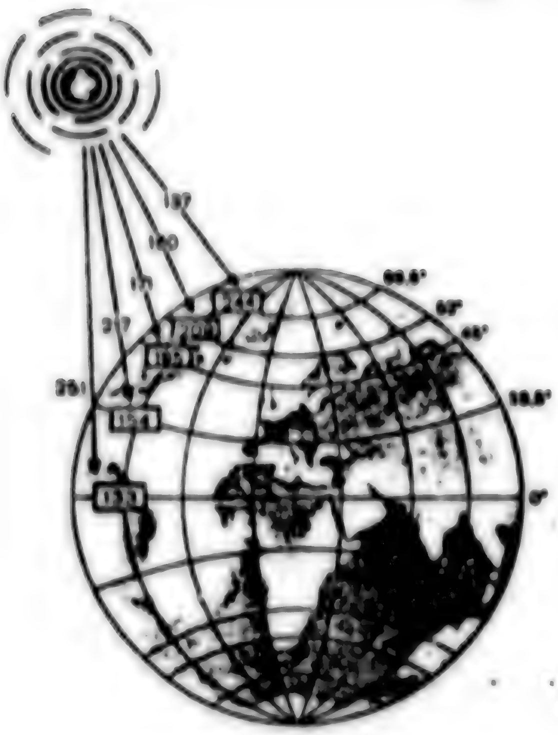
In fact, in order to obtain an annual 2 Q of energy from the heat of the seas and oceans, it is necessary to set aside for the conversion unit for this heat, an area of ocean located between 20° n.l. and 20° s.l., i.e., to cover practically all the tropical and subtropical seas with power engineering units. A direct consequence of this operation will be a decrease in the temperature of the upper layers of the tropical seas by 1°, and correspondingly, a decrease in the average annual temperature of the tropics. At the same time, it is known that the temperature regime in the oceans, especially the tropical seas, considerably influences the climate on a global scale.



Comparison of Annual Energy Demands (Predictable) with Potentialities of Renewable Energy Sources
It is evident that only solar power engineering can provide for all the world energy demands. However, a number of basic features of solar radiation limit its use as a large-scale (several Q) energy source. The color shows the discrepancy in the estimates corresponding to the two versions of stabilization of energy demands [10 and 20 kW (heat) x year/person].
Key:

1. Year
2. Prediction of annual electricity demands
3. Tides
4. Sea waves
5. Wind
6. Hydraulic resources
7. Geothermal resources
8. Heat of seas and oceans
9. Solar radiation (0.5%).

Consequently, the total energy output using the heat of the seas and oceans must be determined to a considerable degree from the condition of minimum disturbance of the thermal regime on the ocean surface. This restriction apparently reduces 100-fold the technical potential of this renewable energy source.



Intensity of Solar Radiation (Average for the Year) and Area of Earth's Surface onto Which a Solar Energy Stream Anually Falls That Equals 1 Q, and Different Latitudes for a Clean Atmosphere.
The numbers above the arrows are the intensity in W/m^2, while the numbers in the rectangles are the area of the surface in thousand km^2.

An analogous situation occurs in the problem of the practical use of geothermal energy sources. The estimate corresponding to output of 1 Q per year is based on the assumption that for these purposes, a percentage of heat of thermal waters is used that is the maximum permissible from an ecological viewpoint and is located in the five-kilometer mass of the earth in the limits of all dry land.[12] Thus, practical realization of the potentialities of geothermal power units is associated with confiscation of considerable territory. For this reason alone, it is impossible to consider that even a small percentage of the technical potential of geothermal resources wil be successfully utilized at some time.

In addition, mineral admixtures extremely complicate the situation. In the first place these are a large quantity of salts, as well as gaseous compounds of mercury, hydrogen sulfide, ammonia gas, carbon dioxide and monoxide, and radioactive elements (^{226}Ra, ^{222}Rn, ^{218}Po, ^{214}Pb, ^{214}Bi and ^{206}Pb). They will come from the earth's depths (in high concentrations) through the wells with the streams of thermal water and steam. The ecological consequences of these discharges are a serious danger for the environment.

It finally should be noted that the majority of thermal water fields are low-temperature. This factor limits their sphere of use mainly for communal-general needs. The development of individual sources of geothermal energy that are located in regions of modern volcanic action is currently the only economically substantiated course.

Thus, as in the case of using the heat of seas and oceans, the actual output of geothermal energy that can be attained even in the distant future will be 100 times lower as compared to the technical potential of its resources (1 Q per year).

Thus, the total technical potential of such renewable energy sources as hydraulic energy, energy of tides, waves, wind, thermal energy of the ocean and earth's depths corresponds to the energy source with output of ~ 3 Q per year. However, ecological, economic and technical reasons limit this indicator, reducing it to a quantity of ~ 0.1 Q per year. This means that the renewable energy sources listed above not only cannot play a role in the future as a large-scale energy source (output of several Q per year), but are not even capable of covering the world's fuel and energy balance shortage that is projected for the beginning of the next century.[13]

Solar Power Engineering

Interest in the use of solar energy has recently risen drastically. Although this source is also among the renewable, the attention that it is given throughout the world forces us to examine its potentialities in a separate chapter.

The potentialities of power engineering that uses solar radiation directly are extremely great. The total quantity of solar energy that passes through the atmosphere and reaches the earth's surface is estimated at 2000 Q per year. The use of only 0.0125% of this amount could provide for all today's world energy needs, while 0.5% would provide for the needs in the future.

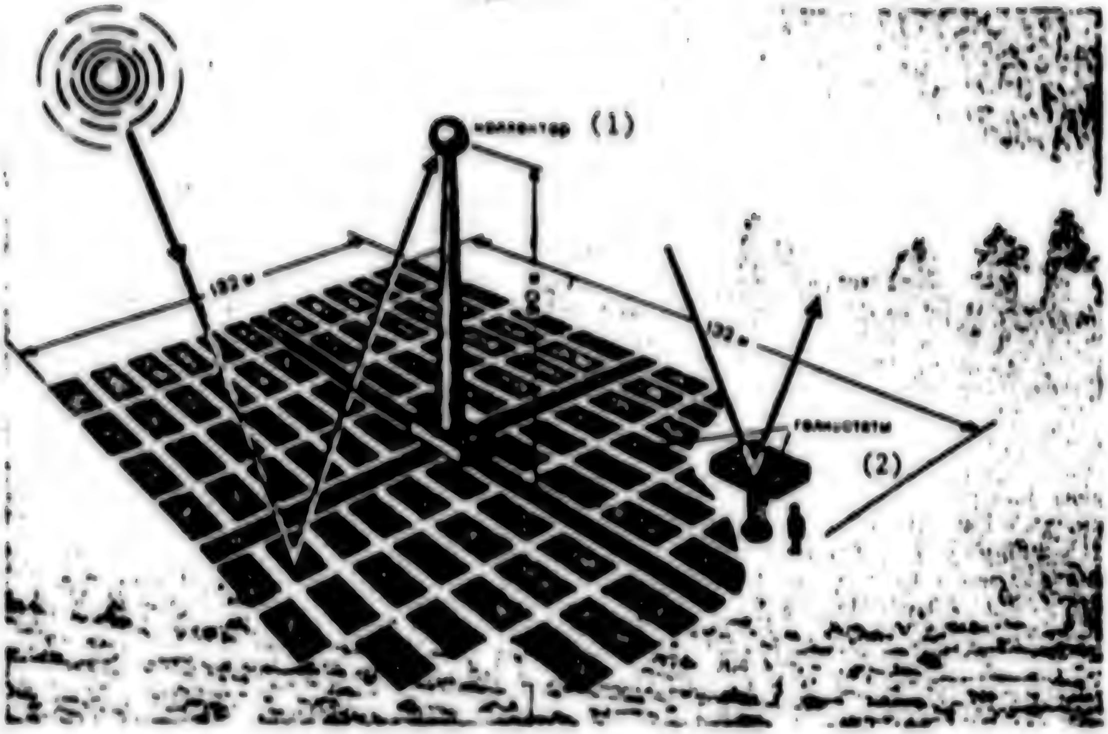
Unfortunately, these enormous potential resources will hardly be successfully realized in large scales at any time.

One of the most serious obstacles is the low intensity of solar radiation. Even with the best atmospheric conditions (southern latitudes and clear sky), the intensity of solar radiation does not average over 250 W/m^2 during the year. Therefore for solar collectors to "collect" energy of 1 Q per year, it is necessary for them to cover a territory of no less than 130,000 km^2!

The need to use enormous sized collectors, in addition, entails considerable consumption of material resources. The simplest solar collector is a blackened metal (generally aluminum) sheet. Pipes with circulating liquid are arranged inside of it. The liquid that is heated by the solar energy absorbed by the collector can be used directly. According to calculations, fabrication of solar collectors with area of 1 km^2 requires ~ 10,000 T of aluminum (we recall that this metal is very susceptible to corrosion).[14] Today's proven world reserves of this metal are evaluated at 1.17 million T. Consequently, if they are even used completely for purposes of solar power enegineering, then collectors with area of 117,000 km^2 can be made. The stream of solar energy that arrives at the earth's surface with this area does not exceed 1 Q per year.

It is already clear from this that important factors exist that limit the output of global solar energy.

We assume that in the future it will become possible to use not only aluminum to make the collectors, but other materials as well. Will the situation change in this case?

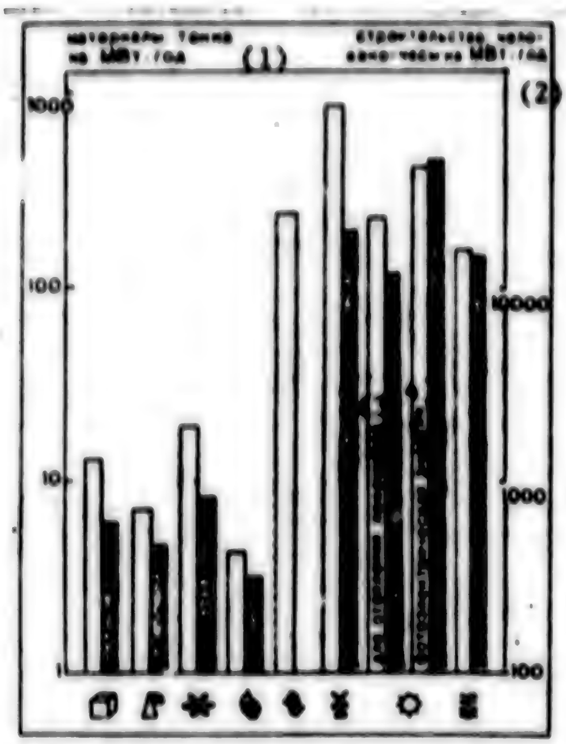


Plan of Device of Solar Thermal Power Station (STES)
The heliostats (mirror modules) track the position of the sun and reflect its rays on the solar radiation collector. The latter is installed in the upper part of the tower and is a system of heat exchangers with heat-carrier flowing through them (water or low-boiling liquid). With the help of the heliostats, the solar radiation is focused on the collector and heats the heat-carrier. The heat is further transmitted from the collector to the electric generator according to the plan used in a standard TES. From the modern technical viewpoint, this method of "collecting" solar radiation, i.e., increase in its intensity 100-fold, is the most promising. The figure shows certain parameters of the experimental industrial STES with "peak" output of 2 MW (el). Its draft was developed in France. It is planned to build it in Targassonne and connect it to the national energy system in 1981.
Key:

1. Collector
2. Heliostats

We will start from the fact that in the distant phase of power engineering development (after the year 2100), all the world energy demands will be satisfied by solar energy (this, of course, is a very rough model). In the framework of the hypothetical model, one can estimate that in this case it will be necessary to "collect" solar energy on an area of from 1 to 3 million km^2. At the same time, the total area of arable land in the world today is 13 million km^2.

One should speak here about the erroneousness of a very popular assertion. It is usually believed that the problem of the earth's resources can be solved if enormous zones of desert are used, or the solar power units are placed in outer space. The error is that only the final stage of the energy cycle is considered, and everything preceding it is ignored, i.e., extraction of the raw material, its enrichment, production of materials, fabrication of the collectors and the



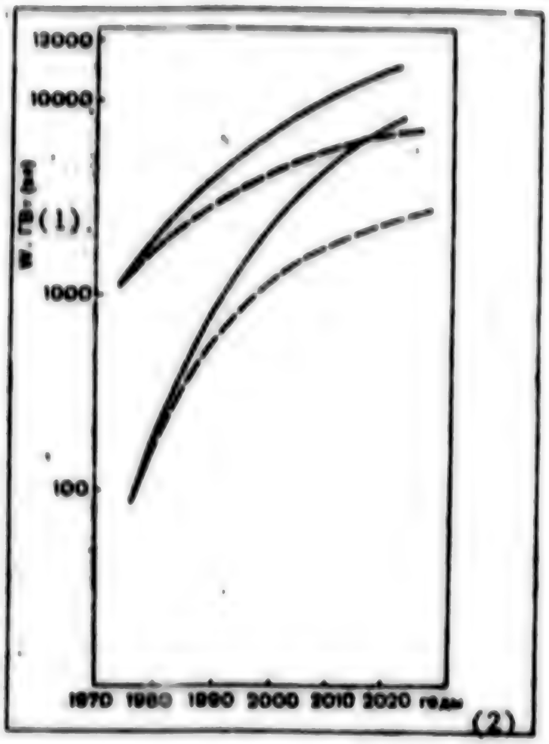
Quantity of Materials and Number of Man-Hours (Shown by Color) Required to Generate a Unit of Energy [1 MW (el) x year] in Different Types of Power Engineering (in Conditions of Canada).
It is evident that the use of renewable energy sources is associated with significantly greater material and labor expenditures.
Key:

❒ Coal
△ Oil
✱ Nuclear energy
● Natural gas
◆ Hydroelectric power
⧗ Wind energy
☼ Solar energy
≋ Heat of seas and oceans

1. Materials, ton per MW x year
2. Construction, man-hours per MW x year
3. For heating rooms
4. Photoelectric energy

equipment necessary for the solar power engineering, and transporting shipments. The enterprises corresponding to these stages (mines, industrial enterprises) must be located in the traditional mining and industrial regions. This will require very significant land resources.

Here it is necessary to take into consideration the second basic aspect of this problem. It has already been stated that solar power engineering is one of the most material-intensive types of energy production. According to the calculations made by the Canadian Atomic Energy Control Board (the main regulating agency for questions of nuclear power engineering in this country), the consumption of



Predictable Demands (W) for Electricity (Shown by Color) and Predictable Rise in Electrical Output of Nuclear Power Engineering with Thermal Neutron Reactors. The solid line corresponds to the maximum prediction, while the dotted to the minimum. With the planned rates of nuclear energy development, the reserves for thermal neutron reactors will be exhausted in the first decades of the future century. It is obvious that nuclear power engineering with thermal neutron reactors with the indicated fuel resources in principle cannot guarantee the creation of major world power engineering. The escape from this situation is to use breeder reactors.

Key:

1. GW (el)
2. Years

materials to build solar energy units that "collect" energy of 1 Q per year will be from 2 to 3 billion T.[15] Consequently, the use of from 8 to 16 Q per year of solar radiation to cover the world fuel and energy balance in the distant phase will require an annual consumption of materials from 16 to 48 billion T! For comparison we will indicate that 4 billion T of oil, about 2 billion T of coal are extracted in the world today every year, and almost 20 billion T of rock are extracted in the form of ore and accompanying rocks.

The following conclusion can be drawn from this comparison. The large-scale use of solar energy entails a giant increase in the demand for materials, and consequently, in labor resources. They must be involved in extraction of raw material, its enrichment, production of materials, fabrication of heliostats, collectors and other apparatus, and their shipping. Calculations show that from 10,000 to 40,000 man-hours are required to produce 1 MW (el) x year of energy in solar power engineering.

A rapid depletion of the reserves of different types of minerals with a simultaneous rise in the cost of their extraction and sharp increase in the cost of land are currently taking place. At the same time, the shortage of labor resources is rising. With time, these problems will become more acute. The listed factors are thus a serious barrier to the development of solar power engineering, at least as a large-scale source of energy with output of several Q per year.

Finally, the widespread assertion regarding the ecological "purity" of solar radiation is an obvious fallacy. During the extraction of the enormous quantity of raw material for solar power engineering, its subsequent enrichment, fabrication of the final product, etc., the environment will be significantly polluted with toxic compounds.

We note here that the placement of solar energy units in space will apparently complicate the solution of the problem of ecological safety even more. In this case, the transmission of energy to earth can only be done in the form of microwave radiation. It is not safe for living organisms, including man.

In summarizing this chapter, we should also note such significant shortcomings of solar radiation as the periodicity of the energy influx during the year and during the day, as well as the nonuniform distribution of heat over the geographical latitudes. The specialists are therefore faced with a serious problem that is associated with developing methods of accumulating considerable energy reserves (in the seasons of maximum solar radiation influx) and its lengthy storage (for use in the periods of reduced influx). This problem, especially if we are concerned with large-scale development of solar energy, has a number of serious unresolved questions of both a technical and scientific nature.[16]

Nuclear Power Engineering and Its Resources

Thus, a detailed consideration of all the factors listed above permitted the MIREK-10 experts to draw the conclusion that by the year 2020, the percentage of renewable energy sources in the world fuel and energy balance may be no more than 13%.

In listing the alternative energy sources that need to be introduced into power engineering, we spoke of nuclear power engineering. What are its potentialities?

There are two methods of "extracting" nuclear energy from atomic nuclei.

One of them, whose industrial realization has already begun, is based on the use of energy released in the chain reaction process of fission of heavy uranium nuclei under the influence of neutrons.

The other method of "extracting" nuclear energy, whose realization is in the stage of scientific developments, is based on the use of energy released during fusion of light nuclei. This method has been called thermonuclear synthesis. The closest to practical realization at present is controllable thermonuclear synthesis of deuterium (D) nuclei with tritium (T) nuclei. Successful fusion of deuterium nuclei to each other is a matter for the distant future.

We will now estimate the resources of nuclear power engineering. It is natural that in the first place it is necessary to estimate the reserves of uranium, since nuclear power engineering today is developing only through construction of AES with reactors that implement a chain nuclear reaction.

Uranium is characterized by fairly broad dispersion. Its average content in the lithosphere is $\sim 3 \times 10^{-4}$ mass %. However, it is economically expedient to work the fields that contain no less than 0.1% uranium. the cost of extracting uranium from these fields is 80 dollars per 1 kg of uranium. Thus, the extractable include reserves that are 1000 times richer in uranium than its average content. According to the latest data given at the IAEA [International Atomic Energy Agency] general conference in 1980, the uranium reserves with a cost of extraction up to 80 dollars per kg are 3.330 million T. The quantity of these reserves in an energy equivalent depends on the type of nuclear reaction in which the uranium fuel will be used. Nuclear power engineering is presently based on construction of an AES with thermal neutron reactors. Unfortunately, these reactors are characterized by an extremely inefficient use of natural uranium reserves.

Thermal neutron reactors "burn" ~1.5% of natural uranium. Since in the process of fission of 1 kg of uranium, 18.8 billion kcal are released, then in thernal neutron reactors, 1 T of natural uranium will produce 282 billion kcal. This is $\sim 11.2 \times 10^{7}$ Q. Consequently, the reserves with cost of extraction to 80 dollars per kg (economically efficient by modern concepts) correspond to an energy source with capacity of 3.7 Q. Of course, these data on uranium reserves are underestimated because of the poor degree of study of many regions. Further exploration will increase the resources of nuclear power engineering with thermal neutron reactors.

However, according to the calculations, at best one can hope that the size of these resources in an energy equivalent will increase only to 20 Q. This means that with the planned rates of nuclear power engineering development, the reliable reserves will be already be exhausted by the end of our century, while the total (reliable and additional) will be exhausted in the first decade of the next century.

Thus, nuclear power engineering with thermal neutron reactors with the indicated resources of fuel in principle cannot guarantee the creation of major world power engineering. The escape from this situation can be found in the use of AES with breeder reactors. With their introduction, the efficient use of natural uranium can reach 30-40%.[17] It is evident that in this case, without increasing the cost of producing energy, uranium resources can be used with a cost of extraction that significantly exceeds 80 dollars/kg. When breeder reactors are used, it is economically advantageous to work fields of sparse uranium ores that only contain 0.06% natural uranium that currently do not have practical importance. The cost of their extraction is ~ 295 dollars per 1 kg of uranium. It is possible that in the future it will be advantageous to use uranium that is contained in sea water and crystal rocks. We should not forget the reserves of thorium. According to available data, the world reserves of thorium are lower than uranium, however, one should bear in mind that they have been studied much less.

According to recent data characterizing the uranium reserves when it is used in thermal neutron reactors and in breeder reactors (see table 2), it follows that the extensive use of AES with breeder reactors can solve the problem of developing power engineering (from the viewpoint of energy resource supply) for many centuries without any fuel limitations.

The fuel resources of nuclear power engineering, besides uranium, as already noted, include reserves of deuterium and tritium. Thermonuclear power engineering, based on synthesis of nuclei of deuterium or nuclei of deuterium and tritium increases the fuel base of nuclear power engineering many times.

In the D-T thermonuclear reaction, the conditionally limiting factor is not the resources of deuterium, but lithium. The fact is that there is no tritium in nature. It can be produced artificially by irradiating a lithium nucleus with neutrons. This can be done on the actual thermonuclear reactor after surrounding it with a special shell made of lithium, and by using a stream of neutrons that develop when the reaction of synthesis of deuterium and tritium nuclei occurs in the thermonuclear reactor. Lithium limits the development of power engineering conditionally since there are sufficient resources to guarantee the demands for many centuries (see table 2). The transition to thermonuclear power engineering based on synthesis of deuterium nuclei alone will afford unlimited potentialities for energy production.

Thus, nuclear power engineering is well supplied with resources. However, the conclusion regarding the need for developing a certain energy source must be based not only on considerations for its fuel resources. It is also necessary to take into consideration the economy of the method of energy production, its technical potentialities and degree of effect on the environment and population.

As analysis shows, nuclear power engineering for these indicators has indisputable advantages over other power sources. Thus, from an economical viewpoint, nuclear power engineering even now has an advantage over power engineering on organic fuel and other energy sources. Further, nuclear power engineering in its technical potentialities can satisfy in a certain form all the energy demands of the fuel and energy balance.

In an approximate calculation it is discovered that the energy demands are distributed as follows: 25% for the production of electricity, 25% for heating residences and other buildings, 25% for industrial purposes, and 25% for transportation. Until now, the general direction of nuclear energy use was its production with the help of electricity at an AES. Consequently, even if all today's power stations were switched to nuclear fuel, then the consumption of organic fuel would be reduced by nor more than 25%. However, the technical potentialities of nuclear energy permit its use for heating and for industry.

The first of the new spheres of application of nuclear reactors is central heating for cities, the creation of atomic heat and electric power stations (ATETs) and and atomic heat supply stations (AST). Several large AST are already being built, and in the future their widespread use should be expected.

Another promising direction is the use of high-temperature gas nuclear reactors to produce high-temperature heat. Many countries have started to work on the use of this heat, for example to produce iron by direct reduction from oxides, and in the chemical industry to produce ammonia, for gasification of coal and cracking liquid hydrocarbons. Especial attention should be given to the use of high-temperature heat to produce hydrogen. The outlooks for the use of hydrogen are simply universal. Its resources are practically unlimited. In power engineering it can displace natural gas completely. This is a convenient energy carrier and ideal fuel from an economic viewpoint. Finally, hydrogen can be widely used as automobile and aviation fuel.[18]

Nuclear power engineering, like other types of industrial activity, has inherent harmful factors that are potentially dangerous for man. Radioactive contamination is the greatest potential danger. However, from the very beginning of the development of nuclear power engineering, its enterprises have been designed so as not to permit the dangerous emission of radioactivity into the environment and to guarantee the maximum safety of the service personnel. The accumulated information regarding the levels of radiation effect, on the individual and collective doses of irradiation of the personnel of the enterprises and the population near the enterprises of the nuclear fuel cycle asserts that the biosphere is sufficiently reliably protected from the radiation effect of the nuclear power engineering enterprises. Of all the currently known methods of producing energy, nuclear power engineering is the least dangerous.[19]

The world energy demands in the next decades will increase intensively. Any one source of energy cannot provide for these demands. It is therefore necessary to develop all energy sources and effectively use the energy resources. In the near phase of power engineering development (up to the year 2000), and in the first decades of its middle phase (after 2000), coal power engineering and nuclear power engineering on thermal neutron reactors remain the most promising. The renewable sources will hardly be successfully developed in the 20th century sufficiently to influence the energy supply on a world scale, although in individual regions these sources can play an important role.

However, in the 21st century, the situation will change, and new energy sources will find broad practical application. In the framework of the nuclear power engineering program, the work on fast and thermonuclear reactors should be activated, as well as the use of nuclear power engineering not only to produce electricity, but also in other spheres (in the first place, to produce industrial and domestic heat).

The energy strategy that is based on the development of all sources of energy, will permit a painless and smooth transition to the distant phase of development of power engineering (after 2100). Here the central place in the energy policy for the distant future should be given to nuclear energy. Solar energy must also occupy a definite place in the fuel and energy balance in the distant phase. However, without practical experience on a large scale, it is difficutl to determine the specific amount of this percentage. Only the development of nuclear power engineering can provide mankind with any necessary quantities of energy and preserve a clean biosphere.

FOOTNOTES

1. See: Arab-Ogly, E. A."Demograficheskiye i ekologicheskiye prognozy" [Demographic and Ecological Predictions], Moscow, Statistika, 1978, p 128.

2. This formula describes a curve that is called the logistic function. It has an S-shape. With small t is rises exponentially, and with large t is asymptotically approaches W_{st} (is stabilized).

3. The quantity 20 kW (heat) x year/person is suggested in the following works: Weinberg, A. M.; and Hammond, "Global Effects of Increased Use of Energy," Geneva, 1971; Legasov, V. A., et al. "Atomic-Hydrogen Power Engineering

(Prediction of Development)," in collection "Voprosy atomnoy nauki i tekhniki, Ser. Atomno-vodorodnay energetika" [Questions of Atomic Science and Technology, Series Atomic-Hydrogen Power Engineering], Moscow, preprint of the I. V. Kurchatov Institute of Atomic Energy, No 1, 1976.

4. 1 Q = 0.25 x 10^{18} kcal = 3.35 x 10^{10} kW (heat) x year is often used in forecasting studies of a unit of energy. Energy of 1 Q is sufficient, for example, to heat all the water of the Aral Sea to boiling point. 1 Q of energy is released when 36 billion T of comparison fuel are burned.

5. The period for mastery by the energy market of new types of energy sources (coverage of 50% of the fuel and energy balance), for example, such as oil, and gas, is 50-100 years for the USSR and the United States. It should be added that there was no ecological crisis or raw material shortage in this period. Under conditions of an exacerbated ecological crisis and rise in the raw material shortage that correspond to today's situation in the world, this period will have a tendency to diminish.

6. According to the calculations (see table 1), by large-scale energy supply one should understand the possibility of producing several units of Q per year (up to 8 Q/year) continually for a thousand years or much more.

7. For more detail see: Mikhaelis, G. "Long-Term Forecasts of Energy Supply," ATOMNAYA TEKHNIKA ZA RUBEZHOM, No 9, 1978, p 9.

8. Ibid.

9. For more detail see: Cohen, B. L. "The Disposal of Radioactive Waste from Fission Reactors," SCIENTIFIC AMERICAN, Vol 263, No 6, 1977, p 21 (see also the translation: UFN, Vol 126, No 1, 1978, p 101).

10. For more detail see: Vokhra, K. G. "Problems of Radiation Protection and Analysis of Danger in Atomic Age," BYULLETEN' MAGATE, Vol 20, No 5, 1978, p 47.

11. For more detail on the use of the ocean's energy see: Akulichev, V. A. "The Ocean and Power Engineering," PRIRODA, No 8, 1979, p 29.

12. Quantitative determination of the maximum permissible percentage of thermal energy of thermal water from an ecological viewpoint that can be used for purposes of geothermal power engineering is based on the condition that disturbances of the water balance of underground water and the thermal balance of the earth do not occur during this use. The article examines the potentialities of geothermal power engineering based on the use of underground thermal water. However, if one includes in the calculation all the earth's crust under the continents, for example, at a depth to 10 km, then the total quantity of geothermal energy that is contained in this layer of dry heated rocks is an enormous quantity equal to 5 x 10^5 Q. However, this estimate has an especially theoretical sense. At the current level of development of science and technology, it is impossible to use this form of geothermal energy. The high degree of dispersion in the earth's crust does not make it possible to use it as a large-scale energy source (several Q per year). It is difficult to imagine that this possibility will arise in the visible future, although some attempts are being made in this direction.

13. Of course, such energy sources must be used everywhere that is technically feasible and economically justified. But their role in the fuel and energy balance does not go beyond the limits of additional, auxiliary resources of the local, and in certain individual cases, regional importance.

14. Udell, S. "Solnechnaya energiya i drugiye al'ternativnyye istochniki energii" [Solar Energy and Other Alternative Energy Sources], Moscow, Znaniye, 1980, p 17.

15. "Risk of Energy Production," Ottawa, Atomic Energy Control Board, No AECB-1119, 1978.

16. Presently in different laboratories throughout the world, important research is being done to convert solar energy using photobiological reactions. In this case, the green plants during photosynthesis "store" solar energy by producing more stable chemical compounds. If necessary, this energy can be realized in the form of heat that is released during combustion of these substances. However, the efficiency of converting solar energy, for example, into electricity, through an intermediate stage of producing plant substance is very low as compared to the efficiency of other methods of energy conversion examined in the article. In addition, one should not think that the phytobiological systems are inexpensive. Significant capital investments are necessary.

17. For more detail see: Kazachkovskiy, O. D ."Fast Neutron Reactors," PRIRODA, No 2, 1980, p 17.

18. For more detail see: Legasov, V. A. "Hydrogen Power Engineering," PRIRODA, No 3, 1977; Kost, M. Ye.; and Ponyatovskiy, Ye. G. "Hydrides in Hydrogen Power Engineering," PRIRODA, No 12, 1980, p 11.

19. For more detail see: Babayev, N. S.; et al. "Ecological Problems of Atomic Power Engineering," PRIRODA, No 10, 1978; Babayev, N. S.; et al. "Safety Problems at Atomic Power Plants," PRIRODA, No 6, 1980, p 30.

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CSO: 1822/130

FUELS

LONG-RANGE PLANNING OF GAS EXTRACTION IN NORTHERN KYUMENSKAYA OBLAST

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR in Russian No 1, 1981 pp 72-79

[Article by N. I. Plyaskina, Novosibirsk State University imeni Leninskiy Komsomol]

[Text] The spatial factor has tremendous significance to development of this region. First, the gas fields are far apart from one another: Thus, the road connecting the Medvezh'ye and Urengoy fields is 120 km long, and that between the Gubkinskoye and Zapolyarnoye gas fields is 260 km long. Second, all gas fields cover a large surface area, and the distances between wells is great: The length of motor roads within the gas fields themselves is 115 km at Medvezh'ye, 175 km at Urengoy, 130 km at the Yamburgskoye field, and 277 km long at the Komsomol'sk field. Third, cargo must be transported to the gas fields by several forms of transportation in succession owing to the significant remoteness of the region from the center of the country, absence of roads, and unfavorable climatic conditions (the rivers have a short navigation season). All of this means higher outlays to deliver cargo and outfit the gas fields: Thus while the proportion of capital invested into development of the production infrastructure is 17-30 percent for the middle Volga regions, and while it is 30 percent for the country as a whole, in this region it attains 50-70 percent.*

This description of the spatial factor of this region demonstrates that development of the infrastructure acquires special significance here.

Retrospective analysis of this region's development would reveal a lag in construction of objects of the infrastructure, which is hindering development of gas industry and making gas extraction more expensive. Analysis of the commissioning of fixed capital in the Tyumengazprom Association in the last few years shows that a significant share of the outlays associated with development of gas fields is invested into facilities of the principal production operation, especially in the first few years. As an example the plan for the Medvezh'ye gas field sets the estimated cost of facilities in the production infrastructure at 64 percent, while the actual proportion of this cost was 30.7 percent as of 1 January 1975. Facilities having auxiliary and service functions are the main ones not yet assimilated: repair production bases, external electric power supply facilities, transportation. Delays in the commissioning of these facilities have made the cost of gas extraction at the Medvezh'ye field 12-15 percent greater. The same trend persists in the efforts to outfit the Urengoy gas field.

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* Tret'yakova, A. P., and Bogopol'skaya, T. I., "Formation of the Production Base of Gas Extraction Regions in Tyumenskaya Oblast," in "Ekonomika, organizatsiya i upravleniye v gazovoy promyshlennosti" [Economics, Organization, and Management in Gas Industry], Moscow, 1976, VNIIGAZprom, No 5, p 10.

As a result the number of workers and the outlays associated with material-technical supply, freight transport, and repair organization are rising significantly. Presently the number of personnel in auxiliary and service operations in the Tyumengazprom Association is significantly larger than that in the principal production operation. The ratio of industrial production personnel per 1 billion m^3 of gas extracted in 1978 by the Tyumengazprom Association is lower than the sector average (25 persons as opposed to 66), and the proportion of nonindustrial personnel exceeds the same for the country as a whole by almost 14 times (180 as opposed to 13). For this reason the total number of workers in the Tyumengazprom Association, per 1 billion m^3 of gas, is five to six times higher than the sector average.

Facilities of the infrastructure are being built without a consideration for their long-range development, meaning that a large number of enterprises with insignificant output capacities are being organized, which correspondingly means lower production effectiveness. Thus the "Nadymgazprom" Association had 36 electric power plants to its credit as of the end of 1977. Despite the fact that most of them use cheap local gas, the cost of the electric power remains rather high owing to the low output capacity of the plants, exceeding the cost of electric power produced by the Surgutskaya GRES by 10-15 times.

An analysis of the existing material-technical supply system of the Medvezh'ye and Urengoy gas fields showed that absence of permanent transportation links is requiring construction of a large number of transloading bases; in this case problems associated with construction and development of the latter are being solved individually for each gas field. The figures show that the total savings in capital investments resulting from the use of transloading bases of some gas fields, coupled with establishment and operation of others, with a consideration for the time factor, will be 130 million rubles.*

Consequently the problem of achieving balanced development of the infrastructure and the principal sectors of material production within this region is acquiring ever-greater importance today. The deadlines for building and commissioning infrastructure facilities must be the principal preconditions for development of the region's gas fields.

In this connection it would be suitable to distinguish three successive stages in the writing of a program for assimilating and developing a gas extraction region. The first stage entails formation of the variants of gas field development, in their dynamics (we used a simulation model for development of a gas field). The second stage involves determining the production variant for development of the region, on the supposition that the plan for the region's gas extraction was written with the help of a sector system model. The third stage involves integrated description of the program for assimilation of the region and development of the gas fields with a consideration for development of the infrastructure's facilities. A network simulation model was used in this stage; this model can be used to obtain and compare a set of plans differing in terms of the time framework of the measures, the dynamics of capital investments, the specific ways they are distributed among facilities, and so on.*

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* Tret'yakova, A. P., and Bogopol'skaya, G. I., Op. cit., p 13.

Sufficiently effective software** was selected for this problem. It provides, for each variant, a list of all possible jobs and events described in the model, and the corresponding integral outlays, defined as the summations of outlays for the planning period.***

The variants of the region's development differ in terms of both total and annual gas extraction volumes. The criterion used to select the optimum variant is the integral effect indicator $U_{\text{Э}}$:

$$U_{\text{Э}}^{r} = \sum_{t=1}^{T} \text{З}_t Q_t^r (1 + E_{\text{НП}})^{t_0 - t} - U_{\text{ЗАТР}}^{r} ,$$

where $U_{\text{ЗАТР}}^{r}$--integral outlays for the r-th variant in the period under examination; З_t--complete outlays on gas; Q_t^r--annual gas extraction volumes for the r-th variant of the region's development; $E_{\text{НП}}$--correction coefficient for outlays made at different times, $E_{\text{НП}} = 0.1$; t_0--the year in relation to which outlays made at different times are corrected.

The long term values of the complete outlays for the northwestern petroleum and gas province are used in the computations as the complete outlays.****

In this stage of the research we devised two network schedules for assimilation and development of the gas extraction region in northern Tyumenskaya Oblast, and we made two series of corresponding calculations. The first series of calculations was based on an enlarged network schedule for the region's development (116 jobs, 99 events) embracing the initial stage of the region's development. The calculations simulated the region's development to 1990 under ideal developmental conditions.

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* In terms of its content, the model of the region is a network schedule bringing together the network models of the gas fields, which are associated with one another by the efforts to create infrastructure facilities intended to service the whole region, and by fictitious associations reflecting temporal dependencies (the duration of such fictitious jobs is zero) having to do with fulfillment of the stages of the program. The principal unit of the model for development of the gas extraction region is the gas field network model.

** The algorithm and software were developed under the guidance of E. Kh. Gimadi at the Institute of Mathematics of the Siberian Department of the USSR Academy of Sciences.

*** The merits of this indicator are brought out by the unique features of gas industry. The requirements and conditions of computing integral indicators are described to some extent in the "Metodicheskiye polozheniya optimal'nogo otraslevogo planirovaniya v promyshlennosti" [Methods of Optimum Sector Planning in Industry] (Novosibirsk, Izd-vo Nauka, 1972, p 111).

****Makarov, A. A., and Vigdorchik, A. G., "Toplivno-energeticheskiy kompleks" [The Fuel and Energy Complex], Moscow, Izd-vo Nauka, 1979.

The second series of calculations was made on the basis of a detailed network schedule (160 jobs, 255 events) for 1980-1990, in which jobs were broken down into those having to do with repair bases, construction industry bases, subsidiary-auxiliary production, engineering support, and material-technical supply to the Medvezh'ye and Urengoy deposits. This last network schedule reflects the region's long-range development with a consideration for the presently evolved situation. Several variants of the region's development were examined in each series of calculations.

The calculations permit acquisition of many results of value to economic analysis. First of all we can use them to find the optimum variant for the region's development. Each job on the network schedule is provided with an expanded temporal description: early and late initiation, early and late termination, and the total time reserve Using these parameters, we can single out jobs defining the total time for fulfilling the entire program--that is, jobs lying on the critical path, and in relation to the rest of the jobs we can determine the most suitable starting times, as allowed by the time reserves.

The variable common to both series of calculations is the order of introduction of the gas fields into operation, which depends on the times of introduction of each gas field and the gas extraction volumes of the latter. Two variants of the order for placing the gas fields into operation, proposed by the TyumenNIIGiprogaz [not further identified], were examined. Both variants account for the fact that the Medvezh'ye gas field was introduced into operation in 1972, and the Urengoy and Vyngapurovskoye gas fields were introduced in 1978. The second variant differs from the first in terms of both extraction volumes and the times at which development of the gas field is started. It proposes increasing gas extraction by raising the intensity of the development of the Urengoy and Yamburgskoye gas fields in the period of growing output, and earlier introduction of the Yamburgskoye (a year earlier) and the Zapolyarnoye (3 years earlier) gas fields into operation. The second variant accounts for introduction of the Komsomol'sk gas field.

Inasmuch as the first series of calculations was made with the assumption that efforts to outfit the gas fields had not yet been started in the region, we were able to vary the starting year for the region's development (1965, 1966, 1970) and the sequence of jobs associated with construction of the Surgut-Urengoy railroad (we were able to vary the topology of the network). Two variants of network topology are examined. The first, presently adopted by the "Tyumenstroyput'" trust, calls for successive construction out from Surgut, and the second, proposed by "Sibgiprotrans", calls for simultaneous construction from two points: Surgut and Noyabr'skaya.

The initial limitations adopted for capital investments were the amount assimilated within the region during the Ninth Five-Year Plan, the amount made by the USSR Gosplan in the 10th Five-Year Plan, and the amount proposed by the USSR Gosplan for the 11th and 12th five-year plans.

Both series of calculations showed that from the standpoint of the selected criterion, the variant calling for increasing annual gas extraction until 1990 is optimum.

Analysis of the temporal associations existing in the different calculation variants showed that development of northern Tyumenskaya Oblast is made unique by the presence of rigid relationships in terms of the times facilities must be placed into operation. Evidence that this is true can be found in the large number of jobs falling on the critical path in both network schedules. The reason for this phenomenon lies in the region's low level of development, making it necessary to finish most of the facilities under construction in a definite sequence. As a consequence if the time of construction of any one of the infrastructure facilities is reduced, the total time for outfitting the region is reduced and, consequently, tightness of the schedule for placing the gas fields into operation is relieved.

The first series of multivariant calculations showed that the Surgut-Urengoy railroad has a great influence upon the time that would be required to place facilities into operation. A network of motor highways connecting the gas fields to the railroad must be created prior to initiation of traffic on this railroad, if uninterrupted deliveries of many types of cargo to the gas fields are to be insured.

Assuming initiation of the region's development in 1965, the optimum variant would be the one in which railroad construction begins simultaneously from two points; the integral effect of this variant is 3 percent greater than that of the variant calling for sequential construction of the different sections of the railroad. The possibilities for accelerating construction of the Surgut-Urengoy railroad are insignificant, since the planned deadlines are rather tight.

The change in the initial year of the region's development automatically reduced the times allocated for outfitting the gas field, and consequently it reduced the possibilities for varying the deadlines for placing facilities of the infrastructure into operation--that is, a more-rigid framework was imposed over each gas field in terms of the time of commissioning of the infrastructure's facilities.

Analysis of the resource associations in the optimum variant of the first series of calculations (having 1965 as the starting year) showed that the schedule for assimilation of capital investments has extremely irregular dynamics. Thus an additional 2 billion rubles of capital investments would be needed in 1970-1977 due to simultaneous construction of the majority of the capital-intensive infrastructure facilities having general-regional and local importance: motor highways and railroads to Urengoy, creation of second and third generations of the region's repair and construction bases, and installation of support facilities for the Vyngapurovskoye and Urengoy gas fields; periods of increasing extraction at the Medvezh'ye gas fields are another reason for the larger capital investments.

Capital investments allocated for 1978-1980 are not utilized fully during this period. Their assimilation is postponed to the 11th and 12th five-year plans. This can be explained by the fact that in terms of the construction plan for the Surgut-Urengoy railroad, the years 1978-1980 are the main construction years. Therefore the volume of capital investments allocated to the development of Tyumenskaya Oblast in 1978-1980 includes outlays on construction of this railroad.

The variant calling for sequential construction of different sections of the railroad is made unique by the distribution of additional annual capital investments in the 1970-1977 period.

The second series of calculations was made with regard to the actual situation with the region's development: As of 1 January 1980, facilities such as local paved motor highways from Nadym and internal motor roads servicing the gas fields and the material-technical supply bases of the Urengoy, Medvezh'ye, and Vyngapurovskoye fields had not been built.

The calculations showed that these facilites of the infrastructure would be built in 1980-1983, at which time the Medvezh'ye, Urengoy, and Vyngapurovskoye gas fields would reach their period of constant extraction, and about 70 percent of the total capital investments on outfitting the gas fields would already be assimilated. Consequently interruptions in the supply of equipment and materials to the fields would continue to be observed in 1980-1983.

Inasmuch as the commissioning of social facilities within the infrastructure also depends on prompt delivery of construction materials (prefabricated reinforced concrete, bricks), the commissioning of housing, public health facilities, and cultural institutions may fall short of the plan as well, which would in turn produce a number of unfavorable consequences such as, for example, high personnel turnover and lower labor productivity.

Consequently because of the desire to hasten the development of the gas fields in 1965-1978, these gas fields had to be developed without adequate roads. This approach was adopted on the basis of short-range advantages in the years immediately following, and so, growth in gas extraction was accompanied by additional outlays on transportation. Consideration of the latter in the calculations would reveal that they reduced the profit enjoyed from gas extraction by 5-7 percent.

From the standpoint of maximizing the integral effect, the optimum variant for the region's development would be the one calling for the second order of introduction of the gas fields, for which the total income would be 44 billion rubles (this would be 6 billion rubles more than in the variant calling for the first order of introduction).

Analysis of the temporal associations in the optimum variants for the region's development showed that if the Zapolyarnoye and Yamburgskoye gas fields were to be placed into operation earlier than in the first variant, the intensity of certain jobs associated with outfitting the gas fields would have to be increased; this would make it possible to reduce the duration of these jobs.

The last measures that must be implemented if the gas fields are to be placed into operation as stipulated in the schedule would require changes in the dynamics of assimilation of capital investments, and corresponding redistribution of the output capacities of construction-installation organizations within the period under examination. Otherwise development of the Zapolyarnoye and Yamburgskoye gas fields would be 2 years behind the stipulated schedule. As a result the quantity of gas which the national economy would fail to receive in 1984-1990 would be such that the integral effect would be reduced by 6.1 billion rubles.

Consequently consideration of all outlays the national economy would have to make due to a shortfall in the planned volume of gas would show that failure to satisfy the conditions for placing support facilities into operation at the Zapolyarnoye and

Yamburgskoye gas fields, as dictated by the network model, would mean a significant increase in integral outlays; consequently another variant would have to be selected as being optimum.

The network model for the region can be used to perform long-range planning of gas extraction and of facilities of the infrastructure as a single system, with a consideration for scarce resources allocated to the region; in particular it can be used to distribute capital investments among different facilities, and determine the schedule for their introduction in such a way as to provide a maximum effect on the national economy from gas extraction. All facilities are associated among each other in terms of both commissioning times and the volumes of capital investments assimilated.

Comparison of the planned deadlines for placing facilities into operation with the calculated times would show that, first of all, the planned schedule for construction of some facilities must be corrected due to the strict mutual relationships existing among such facilities. Second, the plan associates construction of most infrastructure facilities with a certain five-year plan; the network model, meanwhile, can be used to determine the concrete mutually associated deadlines for commissioning facilities within a five-year plan, with a consideration for the allocated annual capital investments.

Thus an analysis of the temporal associations, performed on the basis of the calculations, showed that use of the network models in long-range planning allows us to coordinate construction of different facilities in the infrastructure with the commissioning of the region's gas fields, and consequently to coordinate the activities of a large number of organizations performing the appropriate jobs. The latter is an especially complex problem, one which cannot be effectively solved through sector or territorial planning. Use of the proposed models in the long-range planning of the region would also permit us to eliminate departmental parallelism, construction of redundant facilities, inconsistencies in certain aspects of capital construction, and so on, thus insuring a maximum integral effect from gas extraction in this region.

We can conclude from this that the facility construction schedule corresponding to the optimum variant, obtained by running the network model for the region's development, may be used to write the integrated plan for the region's long-range development in terms of both time and resources.

Analysis of the schedule for assimilating capital investments in accordance with the optimum variant for the region's development, obtained on the basis of the second series of calculations, would show the following. First, implementation of this variant requires 1.6 times more capital investments than planned in the 11th and 12th five-year plans capital investments would have to be increased by 1.8 and 1.6 times. Correspondingly, we would need to increase the output capacities of the construction-installation organizations operating in the region. Second, capital investment assimilation exhibits irregular, discrete dynamics, and the possibility for changing this is nonexistent, inasmuch as analysis of the temporal association showed that only eight jobs offer a time reserve, with a maximum of 0.7 years.

The large amount of capital investments to be assimilated in the 11th and 12th five-year plans is the product of simultaneous construction of the majority of the infrastructure's capital-intensive facilities intended for general-regional and local functions.

Consideration and distribution of capital investments by different departments and organizations participating in the region's development as a single system would permit us to subordinate their operations to the overall goal of the region. This would eliminate the possibility of disproportions, since surplus resources (transportation, the output capacities of construction organizations, capital investments, and so on) would be distributed among departments suffering shortages.

Thus in terms of assimilation of capital investments, the proposed approach to the region's long-range planning eliminates the dependence of the facilities being created upon specific administrative departments.

What would be most interesting is to compare the optimum variants of the first and second series of calculations for the 1980-1990 period--that is, to compare the variant for the region's development in which a integral approach is maintained from the first years of its development, with the variant considering the situation that had evolved as of 1980. This comparison would allow us to determine the total effect resulting from using a long-range systems approach to the region's development, in which the region is viewed as a single whole, the facilities of which are strictly mutually related, and in which the long-range development of each such facility is considered. It should be noted here that in the first series of calculations, the actual developmental situation of the region as of 1965 is taken as the reference point; therefore the results of calculations for 1980-1990 were based on what the calculations showed at the theoretical starting point in 1979. In the second series of calculations the region's actual development in 1979 is taken as the point of reckoning; consequently the results of [illegible]ions for 1980-1990 were obtained on the basis of real initial information. But a comparison may be scientifically grounded only in the event that the network model is tested for its adequacy to the real situation.

Because the model's normative indicators (estimated cost and time of construction of facilities) were determined by computation on the basis of general state norms presently in effect, the results would naturally not be fully consistent. The results may be affected on one hand by inaccuracies in expert generalization of the normative indicators, and on the other hand by deviations of the actual outlays from the estimate norms. But these deviations should not exceed 10-15 percent, if the model is adequate.

We compared the situation that had actually evolved as of 1979 with the calculated situation in terms of the volume and uses of capital investments and the times at which certain facilities were placed into operation. The comparison showed that only 95 percent of the volume of capital investments recommended by the model was actually assimilated in 1979; in this case only 16 percent of this volume was used in the creation of infrastructure facilities (the model called for 44 percent). Therefore as of the end of 1979, only a certain fraction of the facilities of the infrastructure, recommended for introduction on the basis of the calculations, were actually placed into operation. Paved motor roads from Nadym, material-technical supply bases at the gas fields, and other facilities were not placed into operation. These deviations are fully permissible if we consider that the main reason behind the discrepancy between the actual and model data for the region's development in 1979 lies in certain deviations from the path of development recommended by the model calculations for 1965-1979, deviations stemming from imperfections in the system for planning the region's long-range development. First, only 62 percent of the volume of capital investments recommended on the basis of calculations were actually assimilated during this period. Second, the following tendency was observed in the distribution of capital investments for different purposes: The first facilities to actually be created were those which were directly associated with gas extraction, as a result of which the capital investments into extraction are 84 percent of the total volume.

Thus the network model used in the second series of calculations is the result of corrections made in the deviations revealed in 1979. Consequently the results of the second series of calculations, which are based on a real starting point, may be used as recommendations for long-range planning of the region's development in 1980-1990. Assuming the information is available, this model can be used to calculate the figures until the year 2000. At the end of 1980 it would be suitable to correct the starting point and perform the calculations to the year 2001, and so on. The proposed approach to long-range planning based on a network model may be used as a means of long-range planning on a sliding scale.

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11004
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COMMISSION CONSIDERS DEVELOPMENT OF WEST SIBERIAN OIL, GAS

Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 6

[Article: "The Future of an Oil-Bearing Territory"]

[Text] The Commission on Problems of Development of the West Siberian Petroleum-Gas Complex of the Presidium of the USSR Council of Ministers convened in Tyumenskaya Oblast on 25-27 March. It is headed by Deputy Chairman of the USSR Council of Ministers V. E. Dymshits.

The commission acquainted itself with petroleum and gas industry enterprises in relation to the tasks posed by decisions of the 26th CPSU Congress and Comrade L. I. Brezhnev's report to the congress.

In meetings with the directors of enterprises and construction projects, and with elected party officials in Novyy Urengoy, Surgut, and Nizhnevartovsk, the prospects for development of petroleum and gas extraction and power engineering based on natural and by-product gas were subjected to effective discussion. The great significance of hastening the rate of construction of the petrochemical combine in Tobol'sk was noted.

The commission held an expanded session at the Tyumenskaya CPSU Obkom, in which ministry and department officials and the oblast's party and soviet executives participated. The state of affairs of and measures to support fulfillment of the CPSU Central Committee and USSR Council of Ministers decree on construction of residential buildings, cultural and personal facilities, and paved roads in petroleum and gas extraction regions of West Siberia were examined.

The importance and timeliness of creating the commission, the need for which was stated in Comrade L. I. Brezhnev's report to the party congress, were noted. In this five-year plan Tyumenskaya Oblast is to extract as much petroleum and twice more gas than in all of the time since the fields were first subjected to development.

A complex of measures to improve production organization, working conditions, and living conditions is to be enacted. The work of the commission will make it possible to coordinate the activities of organizations and departments more clearly, to control territorial-production complexes more effectively, and to account for and resolve the interests of different sectors. The participants of the meeting devoted special attention to improving capital construction, concentrating resources on pilot facilities, and reducing the volume of unfinished construction.

Participants of the commission's proceedings included Tyumenskaya CPSU Obkom First Secretary G. P. Bogomyakov, USSR Gosplan Deputy Chairman A. M. Lalayants, and executives of the councils of ministers of a number of union republics.

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UKRAINIAN COAL MINES INTRODUCING QUALITY CONTROL SYSTEMS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Mar 81 p 2

[Article by V. Chernenkov, secretary of the Chervonograd city committee of the Communist Party of the Ukraine: "Standards Enter the Mine"]

[Text] The experience of the workers of L'vov in developing and introducing a comprehensive quality control system for output is well-known in our country. The pioneers of this work were machine building and instrument making enterprises. Then the baton was passed to the textile, garment, food, chemical, and metallurgical workers. And only the mining sectors, in particular the coal industry, remained for a long time "out of the main stream." There were reasons for this.

In the first place, every time the subject of coal was discussed the quantitative indicator was paramount. In the second place, the principles of structuring a comprehensive quality control system did not seem applicable in the mine. After all, the quality control system is a program of measures, methods, and means that insure and maintain the necessary level of output quality during its development, manufacture, circulation, and use or consumption. But miners are dealing with output produced by nature itself.

All the same, the quality of coal does not depend entirely on nature; human beings also play a part. And the more intensively coal seams are worked in the old basins, the more apparent this relationship becomes. Miners must work thin seams with more and more unproductive rock. This means that the ash content of the coal increases and its caloric value becomes lower. But here it already depends primarily on the miners themselves, how much rock is mixed into the market fuel. Certain stimuli, technical and social measures, and administrative decisions are necessary to minimize it. In other words, a coal quality control system is needed. Specialists from the Ukrzapadugol' [Western Ukraine Coal] Association with scientists from the Donets Coal Institute began work on this several years ago. The scientists and practical workers tailored the comprehensive quality control system to mine conditions; they adopted some things and threw out others. But the cornerstone of the L'vov system remained unchanged. This is enterprise standards.

The coal miners now have 11 such standards. A few examples are "Monitoring the Quality of Work by Mine Employees," "Information on the Quality of Coal Mines," "Organization of Socialist Competition," and "Planning Mine Work with Due Regard for the Quality of Coal Mined." The standards replaced the numerous, uncoordinated official instructions and precisely regulated the activities (and responsibilities) of all services. All the enterprise's standards have a single purpose: the final product and its quality.

The Order of the Red Banner Velikomostovskaya Mine No 3, whose collective has always been outstanding for stable work and shown an interest in innovations and technology and production administrations, made a practical test of the standards.

During development of the mine standards specialists asked themselves one question: what are the main things that affect the quality of coal? The answer they found was: the quality of labor. The second question, precisely whose labor is decisive — miners, transportation workers, or engineers — was more difficult to answer.

It was commonly thought that everything depended on the miners themselves, on their skill and efforts. Therefore, the key to quality is in their hands. But when they studied the matter, it turned out that this was not true. If the preparatory workers are careless in preparing spaces for exploitation one can hardly expect high quality coal. A "humped" longwall always produces a large amount of unproductive rock. So they began studying the activities of the other mine services, and came to the conclusion that they all have some degree of influence on the quality of the final product. Thus, evaluation coefficients are needed for the labor of all mine employees. So such coefficients were worked out.

The worker learns of his contribution to the common cause immediately after the shift is over. The mine foreman, consulting with the brigade leaders, enters the coefficient he has earned in a job log, and on the surface writes it in a table. It is interesting that the mine did not have a single conflict about these entries, even though 624 coefficients of less than one were recorded in a year. Why? It was because the "victim" received the information immediately, while still among his fellow workers who had witnessed his mistakes and omissions.

I have heard miners say to their comrades, with some humor, "You probably scold your son for getting '2's' but you yourself cannot even make a '1'!" But, of course, it is not a joking matter. The point is that after introduction of the system the miners' attitude toward the quality of the coal changed radically.

I recall a worker meeting in mine No 3, concerned with coal quality. The miners of section No 1, who had produced coal with a higher ash content, were particularly criticized. "But it is very hard to avoid cutting unproductive rock," A. Patyka, section chief, explained the situation, "when the seam is no more than a meter thick. We do not have cutters narrow enough to take only coal." These were sensible words and they decided not to submit a complaint against the section.

But then the quality control system was introduced, and section No 1 quickly met the ash content norm and the began to lower it. Alekaey Ivanovich now reasons differently: "If ,ou adjust the cutting complex very well and watch its work constantly, you can avoid cutting unproductive rock."

Each service at the mine has its own specific traits, and this means that specific criteria are required to evaluate the activities of the different subdivisions. Hard and fast rules are unacceptable. The developers of the standards provided for special lists of evaluation indicators for the quality of labor of different categories of employees: face preparation workers; brigades of support installers, surface workers, engineering-technical personnel, preparation and repair services, internal mine transportation, and the like. I will not claim that all the variations have been adequately tested already, but no one doubts the usefulness of the initiative.

Parallel with the experiment at Velikomostovskaya No 3, a great deal of work was begun under the direction of the city party committee to publicize the comprehensive output quality control system at mines in the basin. Specialists spoke to workers and explained the basic principles of the system. Coordinating groups were formed. A quality methods office was opened at the House of Scientific-Technical Information of the Association, and similar offices soon appeared at a number of mines. One of the forms of propagandizing the comprehensive system of output quality control was schools for progressive labor techniques. A basin-wide practical seminar on the topic "Quality Control in the Coal Industry" was held at mine No 3 on the initiative of the city party committee, in cooperation with the Donets Coal Institute.

Now let us briefly consider efficiency. The collective of Velikomostovskaya Mine No 3 completed the five-year plan for all basic indicators ahead of schedule. The ash content of the coal was 0.2 percent lower than the plan, and in the last two years the mine's customers did not send in a single complaint. The Ukrainian SSR Ministry of Coal Industry has agreed to introduce comprehensive output quality control systems for coal at all mines of the basin in the first year of the 11th Five-Year Plan. This will be a concrete contribution by the miners of the Western Ukraine to practical realization of the challenge posed in the "Basic Directions" for raising coal quality.

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FUELS

CONSTRUCTION WORK PROCEEDS TO CONVERT SAMOTLOR DEPOSIT TO GASLIFT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Mar 81 p 1

[Article by Yu. Belanov, Tyumen": "Samotlor Gets Its 'Second Wind'"]

> [Text] "The extraction of gas and petroleum in Western Siberia and the transportation of these products to the European part of the country will be the key elements of the energy program of the 11th Five-Year Plan, and of the 12th Five-Year Plan as well." (From the Accountability Report of the CPSU Central Committee to the 26th Party Congress)

The Samotlor petroleum deposit needed engineering support in the form of the gaslift technique to get its "second wind."

The gaslift technique differs from other techniques of mechanized petroleum extraction in that it has a higher degree of automation of all industrial processes. A microcomputer is installed at the cluster of wells. It insures an optimal economic regime for each operating well and transmits raw data to the petroleum extraction shop, to the regional computer. From there all production-technical data goes to the dispatcher at the computer center. In addition, with the gaslift method of petroleum extraction it is possible to make a well yield almost any amount, from zero to the maximum. In short, when the intricate complex of construction and installation work is done well, gaslift compressor plants provide the foundation for highly efficient petroleum extraction.

"The volume of construction and installation that must be done to set up a gaslift complex at Samotlor is fairly large, more than 75 million rubles," said B. Yermolov, senior production engineer in the gaslift well operation division of the Nizhnevartovskneft' [Nizhnevartovsk Petroleum] Petroleum-Gas Extraction Administration. "We have to build six compressor plants, more than 500 kilometers of high-pressure gas pipelines, and 227 kilometers of remote control lines and set up 215 clusters of wells for gaslift. All the Samotlor wells are to be transferred to this progressive method of petroleum extraction in 1983."

It is certainly a difficult and demanding program, but intensive work is already underway to carry it out.

The dump trucks carrying mortar were coming one after the other to the construction site of the gaslift compressor plant and S. Konikov, project supervisor of Construction Administration No 44 of the Samotlorneftepromstroy [Samotlor Petroleum Industry Construction] Trust, was forced to give this brief interview on the run:

"The fill has been poured, underground utility lines are being laid, and the grating foundations of the compressor are being cemented."

They are keeping a close eye on the quality of foundation construction here. This is not surprising, because each compressor of the future plant weighs 38 tons and the engine shaft turns at tens of thousands of rpm. It is not accidental that this important sector of the project was assigned to the brigade of the well-known construction worker , Hero of Socialist Labor and Winner of the USSR State Prize N. Nezhdanov. Welder P. Kul'matitskiy, masonry worker A. Kozhevnikov, and machine operator N. Karlykov do their jobs outstandingly and significantly surpass their shift assignments every day.

The jobs at this highly complex start-up project of the first year of the new five-year plan have been declared shock work and are being done on an integrated basis. In a few days the construction workers will begin installing the frames of the buildings of the compressor shop.

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FUELS

STATUS OF SYNTHETIC FUEL RESEARCH, DEVELOPMENT SUMMARIZED

Moscow IZVESTIYA in Russian 24 Apr 81 p 2

[Article by Academician A. Sheyndlin, chairman, Coordinating Council on the Problem "Synthetic Fuel", and Doctor of Chemical Sciences I. Kalechits, chief, Chemical Division, USSR State Committee for Science and Technology: "Gasoline From Coal"]

[Text] The fact that the planet's oil reserves are 10 times lower than its coal reserves has now been known for a hundred years. Now that geologic investigation of the earth, including the sea shelves, is nearing completion, we can treat the figures describing the world oil reserves as sufficiently reliable. Most predictions estimate the explored recoverable reserves as an amount sufficient for only 30 years, assuming the present level of their annual extraction is maintained.

All of this pertains to a certain extent to the natural gas reserves. But at the same time, according to data of the last world energy conference, the explored recoverable coal reserves exceed the reserves of oil and gas taken together by almost a factor of three. It would seem that considering the danger of depletion of the oil reserves, and the continuous growth of oil prices, the solution to the problem would be quite simple: We need to switch to production of liquid fuels from coal, all the more so because this had been done on an industrial scale in prewar Germany, large facilities had operated in England, Japan, and the Soviet Union, and the appropriate technology has been described in many monographs, and even in VUZ textbooks.

We should not fail to note that this problem has attracted great attention from scientists and engineers of the whole world; moreover in the last decade it has been the focal point of programs enjoying generous government financing. Such national programs can be found in the USA, Great Britian, and a number of other countries. But industrial enterprises are still nonexistent, if we disregard a relatively small plant in the UAR where, incidentally, an indirect process is used to transform coal into liquid fuel: First the coal is gasified, and then liquid products are obtained from the gas.

Where do the conflicts lie? Why is it so difficult to introduce a process which had been known in the past? The difficulties are many, both technical and economic.

First of all, it is extremely difficult to liquefy coal. Coal differs from petroleum not only in its aggregate state, but also in its composition: Coal contains up to

20 percent oxygen while petroleum contains not more than 1 percent; there is much more hydrogen in petroleum than in coal and, most importantly, even following concentration, a 3-5 percent ash content still persists in coal, while ash is practically nonexistent in petroleum. Direct saturation of the organic mass of coal with hydrogen is possible only with the help of catalysts, but the latter unavoidably mix with the ash, and are lost. Owing to this, cheap but, alas, not very active catalysts must be used, and the process must be conducted in the presence of high pressures and temperatures.

Therefore the apparatus involved is complex and expensive. After all, it must not only operate in the presence of high temperatures and pressures, but it must also be resistant to corrosion by hydrogen and hydrogen sulfide, and to erosion by ash particles. Owing to this, the capital investment per ton of output capacity of an operation producing synthetic fuel from coal is estimated in foreign plans at $500-800. In other words erection of even a relatively small plant which produces, for example, 5 million tons of fuel per year would cost $2.5-4 billion. The conclusion is that we cannot solve the problem of synthetic fuel with old technology. We need to find new ways.

The need for finding new ways to process coal into synthetic fuel may be illustrated once again by some simple calculations. All processes described to date for liquefying coal to an extent insuring full processing of the raw material require a very slow rate of the raw material's movement through the reactor. As a consequence only 1,600-2,400 tons of liquid fuel can be obtained annually from 1 cubic meter of useful reactor space. We should add to this that a standard reactor operating at a pressure of 300-700 atmospheres and having a useful volume of 8 cubic meters weighs 120 tons. Consequently a plant with an output capacity of 5 million tons per year would need 260-390 reactors weighing 31,200-46,800 tons!

This means that we need to develop fundamental research, seek simpler and cheaper concepts to be used in the creation of new, more-effective production processes, find new, reliable apparatus designs, and accumulate the engineering experience associated with operation of such apparatus.

The level of exploratory and fundamental research being conducted on this problem today in our country is not inferior to that abroad; some of our developments are even bolder and more original. But we have fallen significantly behind in accumulation of engineering experience. Many variants of thermal processing and of direct liquefaction and gasification of coal have been tested abroad in large experimental industrial facilities (with a productivity of 6-25 tons per day). Even larger facilities for liquefaction of coal have been created by a number of firms, and industrial facilities are on the planning boards.

It will not be until the end of 1981 that we will possess a large experimental industrial power engineering facility with a productivity of 175 tons of fuel per hour (using a process in which liquid tar is obtained by high-speed pyrolysis). The first hydrogenating facility, which will have a productivity of 7-10 tons per day, will begin operating in 1983. Thus we are starting these efforts late. Therefore it would be extremely important to initiate fundamental research aimed at accelerating the experimental testing stage. This research must include the study of hydrodynamics and heat and mass transfer in a complex multiphasal coal hydrogenation system, problems associated with optimizing the design of reactors, gas generators, and other apparatus, problems associated with selecting corrosion- and erosion-resistant materials, and others.

This research will require clear organization. A specific-purpose integrated program concerned with acquisition of synthetic liquid fuels from Kansk-Achinsk coal in 1981-1985 was developed by academy and sector institutes and approved by the USSR Committee for Science and Technology, the USSR Gosplan, and the Academy of Sciences. The program foresees erection and experimental operation of large facilities intended for coal hydrogenation, gasification, fuel processing, and synthesis of methanol and hydrocarbons from carbon and hydrogen oxides; it also calls for corresponding exploratory and fundamental research, and creation of experimental bases, to include at the "Azot" Production Association in Shchekino, and in Shatura, where a subdivision of the USSR Academy of Sciences' High Temperature Institute is being created.

The significance of the program is obvious. In fact, although our country's demand for oil and gas is fully satisfied today, and even though extraction of these minerals will even increase in the 11th Five-Year Plan, we are obligated to prepare technically in the foreseeable future for the time when decreasing petroleum extraction will have to be compensated by synthetic fuel production. Making his report to the 26th CPSU Congress, Comrade L. I. Brezhnev said in this connection: "Looking into the future, we should also work substantially on the problem of producing synthetic liquid fuel out of coal from the Kansk-Achinsk basin." And on the scale of our national economy as a whole, we would need large plants, and for practical purposes it would become necessary to create a new sector. After all, if we assume that a minimum of 30 billion rubles of capital investments would be required in support of the production of 100 million tons of synthetic petroleum per year, assimilation of this amount would need something on the order of 10 years, and even a 10 percent reduction in outlays resulting from better scientific and engineering concepts would mean a multibillion savings of national assets.

The program foresees experimental industrial testing of all possible variants, so as to permit selection of the best of those tested. Therefore it is an intersector program, with about 20 ministries and departments participating in it. It is very important for the executor ministries to avoid local bureaucratic interests in their work on this assignment. The slowness with which experimental and experimental industrial facilities are being erected raises special apprehensions. The USSR Ministry of Coal Industry took several years to plan the first experimental facility with a productivity of 7-10 tons per day, and it was not until the present year that its erection began in Tul'skaya Oblast. All of the necessary concepts have still not been worked out yet for an experimental industrial facility with a productivity of 500 tons per day, one which is to embody all of the best results of the program in the 11th Five-Year Plan. This will make the planning work difficult. Since 1975 the Ministry of Power and Electrification has been building a high-speed coal pyrolysis facility in Krasnoyarsk. It was supposed to have gone into operation back in 1979, but it has still not been finished. This facility will produce coal tar, but shops intended to process the tar into liquid fuel have been provided with neither the plans nor the financing yet. The Ministry of Chemical Industry has not resolved the issue of reconstructing a coal gasification facility at the Shchekino "Azot" Production Association. In addition to these facilities, we must still build facilities to process shale in the Estonian SSR, facilities producing high-octane gasoline out of methanol, facilities gasifying coal at high temperatures and pressures, on-site coal gasification facilities (as components of thermal electric power plants), and a number of other facilities. Processing of the raw data and the planning and construction of experimental facilities must be at the center of attention of not only the coordinating council but also the client ministries, the ministries responsible for construction and installation, and local party and soviet organs.

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FUELS

PETROLEUM INDUSTRY STATUS, PROSPECTS SUMMARIZED

Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 2

[Article: "Development of Petroleum Industry, a Review"]

[Text] The 11th Five-Year Plan is the first stage in implementation of the Soviet Union's energy program, presently under development. In addition to forcing development of electric power engineering and gas industry, there are great and complex tasks facing the workers of petroleum industry.

They have a good foundation from which to work. Extraction of petroleum, including gas condensates, increased to 603 million tons last year. The total national increment in petroleum extraction in the 10th Five-Year Plan was provided by the fuel and power complex of northerwestern Siberia. In 5 years, the region's petroleum extraction increased by almost 165 million tons, and in 1980 it exceeded 312 million tons. In this case the volume of drilling operations increased by more than a factor of three.

A total of about 28,000 new wells and more than 11,000 kilometers of oil and petroleum product pipelines were placed into operation in the sector during the 5 years.

The commissioning of more than 100 fully automated oilfields promoted growth in production effectiveness. The output capacity of the by-product petroleum gas sector was practically doubled, which made it possible to significantly reduce gas losses. The duration of the well construction cycle was shortened by more than a third on the average.

A broad complex of measures aimed at improving the working, personal, and resting condition of the oilmen was implemented. About 6 million square meters of fully outfitted residential space, polyclinics, schools, and other social and cultural facilities were built for them.

Tyumen' oilmen achieved a remarkable labor victory--they reached their five-year target ahead of schedule.

And within the sector as a whole, the collectives of about 600 enterprises completed their five-year plans ahead of schedule. Mention should be made of the work of "Bashneft'" laborers. In the 5 years, they kept the oil extraction level high--40 million tons on the average--in difficult mining and geological conditions significantly depleted, old deposits.

Reference Points for the 11th Five-Year Plan

According to the present five-year plan, oil extraction (together with gas condensate) is to be increased to 620-645 million tons in 1985; this includes up to 385-395 million tons in Tyumenskaya and Tomskaya oblasts.

Oilfields in new remote and inaccessible regions must be developed in the current five-year plan. Consequently the outlays on petroleum extraction and the volumes of drilling and construction jobs are rising. Thus twice as many production wells are to be drilled in 1981-1985 as in the 10th Five-Year Plan.

There are plans for tripling the volume of production drilling and commissioning 25,000 new wells in West Siberia. This is to be accompanied by equivalent growth in the equipment servicing the oilfields (oilfield pipelines, oil preparation facilities, water pumping devices used to maintain reservoir pressure, and other objects).

Broad use of industrial construction methods and automated and modular equipment exhibiting a high degree of prefabrication is the key to solving this problem. Enterprises of the Ministry of Chemical and Petroleum Machine Building must expand production of such equipment, as required by the orders of oilmen in Tyumenskaya Oblast and other region .

Much work is to be done in the next few years in West Siberia to convert the wells to mechanized extraction. The number of such wells must be increased by four and a half times in 5 years.

Kazakhstan is to increase its petroleum extraction. New oilfields have been discovered there in the last few years, in Aktyubinskaya, Gur'yevskaya, and Mangyshlakskaya oblasts. This will make it possible to increase the republic's oil extraction (together with gas condensate) to 25 million tons in 1985, as compared with 18.7 million tons in 1980.

Efforts to form the fuel and power complex in the Komi ASSR are continuing. There are plans for obtaining 23 million tons of petroleum, including gas condensate, in 1985, meaning a 27 percent increase in comparison with 1980. Oilmen of the Ural-Volga, Azerbaijan, Ukraine, the Turkmen SSR, Georgia, Belorussia, and Uzbekistan will make their contribution to the targets of the five-year plan.

Further growth in production effectiveness is associated with more-sensible use of by-product petroleum gas. For the moment we are utilizing 70 percent of this valuable raw material. By 1985, we must increase the selection and processing of not less than 85 percent of the by-product gas.

Soviet oilmen are expanding multilateral cooperation with socialist countries. Such cooperation is serving as the framework for solving major problems associated with development of petroleum industry in the CEMA countries, problems spelled out in the Integrated Program of Socialist Economic Integration, and in the long-range specific-purpose programs of the 11th Five-Year Plan. Active efforts are being made to automate production processes and introduce new petroleum extraction methods, highly effective chemical reagents, and so on.

The Soviet Union supplies a significant quantity of oil and natural gas to the CEMA countries, and in return it receives large quantities of drilling, electrical engineering, and oilfield equipment, communication apparatus and resources, and various forms of machines and mechanisms. This is having a favorable effect on development of the fuel sectors of all socialist countries.

The Period of Accelerated Reequipment

Stable growth of petroleum extraction is based on broad introduction of the achievements of science and technology. The Soviet Union is known to occupy the leading positions in oilfield development. Methods for maintaining reservoir pressure employing artificial flooding--90 percent of the petroleum is now being extracted with their help--enjoyed widespread introduction. The 11th Five-Year Plan is a period of accelerated reequipment of all subsectors of petroleum industry.

The 26th CPSU Congress pointed out that there were tremendous reserves for raising the recoverability of petroleum from the subsoil. A specific-purpose scientific-technical program was developed in support of this important task. It includes introduction of thermal and physicochemical methods, and creation of new industrial processes used to keep the oil beds productive. The most effective methods involve injection, into productive beds, of water treated by various surfactants, and high-pressure steam.

New methods promising a rise in the oil output of the beds of more than a hundred oilfields in West Siberia, the Kazakh SSR, the Komi ASSR, the Ukraine, and other regions are to be subjected to major testing.

One task of great importance is to expand the use of the progressive gas-lift method of well exploitation. It increases the time of well operation between repairs by six to eight times in comparison with wells outfitted with conventional submersible pumps.

The bulk of the wells exploiting the known Samotlor oilfields are to be converted to gas-lift operation as a way to keep the extraction volume high. And in the sector as a whole, the number of gas-lift wells must be increased from 2,300 to 6,500, and their extraction volumes must be increased from 22 to 58 million tons. The assignments to produce the appropriate underground equipment, modular gas-distribution batteries, and other equipment have been submitted to the Ministry of Chemical and Petroleum Machine Building, the Ministry of Instrument Making, Automation Equipment, and Control Systems, and the Ministry of Electrical Equipment Industry.

Highly productive, reliable submersible pumps will enjoy broad application. A third of all petroleum is now being extracted with their assistance. By the end of the five-year plan, this proportion should rise to 40 percent.

1981 Target for Oil Extraction
(Including Gas Condensate)
(Millions of Tons)

Glavtyumenneftegaz	323.5
Tatneft'	75.1
Bashneft'	38.8
Kuybyshevneft'	23.1
Komineft'	19.4
Azerbaydzhan	14.8
Mangyshlakneft'	14.8
Permneft'	13.9
Orenburgneft'	11.0
Tomskneft'	10.8

According to the Basic Directions, the proportion of oil extraction by fully automated oilfields is to be increased to 80-90 percent in 1985; labor outlays associated with servicing each well are to be decreased by 15-18 percent. It is with this purpose that the Ministry of Petroleum Industry is installing automatic and remote control devices at about 90 more oilfields, and more than 5,000 group measuring systems.

Creation of new oil extraction capacities depends to a decisive extent on growth in drilling operations, and in their effectiveness. The total drilling volume for 1985 will be about 35 million meters. The rate at which production wells are to be sunk must increase by 40 percent, and the average output per team must exceed 21,000 meters per year. Accelerated reequipment and improvement of drilling processes and organizations will be the basis for achieving such indicators.

The Ministry of Chemical and Petroleum Machine Building will have to produce more integrated multipurpose drilling rigs, and expand the nomenclature and upgrade the quality of drilling engines and bits. Oilmen are waiting for high-strength drilling tubes and casings from the USSR Ministry of Ferrous Metallurgy.

Recently the Ministry of Petroleum Industry reorganized well construction: Specialized administrations have been created in place of the former drilling offices. A new order of planning and economic stimulation is being introduced, and the system of planning and evaluation indicators is being improved. But the anticipated results are not being achieved in all cases. The rate of well construction often remains inadequate, and the experience of competition leaders is not enjoying broad dissemination.

The expeditionary shift method has a special place among the system of measures to organize drilling operations. This method is to be used in 1981 to complete 4.4 million meters of wells, as opposed to 2.6 million meters in 1980.

All-Out Economization of Extracted Oil

Oil extraction in new northern regions far away from inhabited places is getting more and more expensive. The impact from saving each ton of fuel is becoming more substantial. Specialists have estimated that outlays on measures to economize on fuel, mainly petroleum, have been two to three times below the increment in outlays on extraction and transportation to consumers.

The workers themselves of petroleum industry must serve as an example of a thrifty attitude toward petroleum. Last year the Glavtransneft' suffered above-standard losses of "black gold". They were the result of various sorts of spills, including ones associated with pipeline mishaps. The losses of petroleum gas at oilfields of West Siberia and some other regions are still sizeable.

More than a third of the electric power produced by thermal electric power plants is still being produced with fuel oil. During the present five-year plan, the state regional electric power plants are to reduce the proportion of petroleum they use as fuel, replacing it with gas and coal. Other fuel-consuming sectors are to follow the same route as well.

The obligation of the petroleum refiners is to produce more light petroleum products from every ton of crude, and to insure full processing of the petroleum.

This year oil extraction (including gas condensate) is to be increased to 610 million tons, meaning a 7 million ton increase over last year. West Siberia (Tyumenskaya and Tomskaya oblasts) is to play the main role in this task. Here, extraction will increase by more than 22 million tons.

The petroleum extraction target for the first 2 months has been practically reached by all of the sector's production associations. The best results were achieved in the all-union competition by oilmen of West Siberia, the Komi ASSR, the Tatar ASSR, the Udmurt ASSR, Kazakhstan, the Checheno-Ingush ASSR, and Orenburgskaya and Kuybyshevskaya oblasts. In the country as a whole, the plan for January-February was exceeded by more than 620,000 tons of petroleum.

Effective utilization of existing output capacities, the commissioning of new wells, and raising labor productivity will insure successful fulfillment of the annual plan.

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FUELS

URENGOY GAS FIELD PRODUCTION GROWING

Moscow EKONOMICHESKAYA GAZETA in Russian No 12, Mar 81 p 3

[Article by Operator V. Zakharenkov, "Urengoygazdobycha" Association: "Urengoy: 100 Million Cubic Meters of Gas in Excess of the Plan"]

[Text] The laborers of West Siberia attentively followed the proceedings of the 26th CPSU Congress. We know that fulfillment of its decisions would mean further blossoming of our vast corner of the earth. Comrade L. I. Brezhnev said from the podium of the Kremlin Palace of Congresses: "I feel it necessary to single out rapid increase in Siberian gas extraction as a task of priority economic and political importance. The gas fields of the West Siberian region are unique." The party views extraction of gas and oil in West Siberia and its conveyance into the European part of the country as the most important element of the energy program for the 11th and 12th five-year plans.

All who have been given the honor of developing the gas treasurehouse of the unique Urengoy gas field are responding to the decisions of the congress with shock labor. While the congress was in session, they filled the Tyumen' section of the new Urengoy-Gryazovets-Moscow ring pipeline with gas, after its completion by builders of Glavtyumen'truboprovodstroy ahead of schedule. Another labor victory was won during the same time period: Together with oilmen, builders successfully tested the field's fifth facility for integrated preparation of gas for transportation. It is more powerful and more economical than previous ones. Our association's collective decided to achieve its planned output capacity a month ahead of schedule. We plan to place subsequent facilities into operation just as quickly.

In all by the end of the five-year plan, output capacities capable of extracting 230-250 billion cubic meters of "blue fuel" and gas condensate will be put into operation in Urengoy. For this purpose the association will introduce fixed capital worth almost 400 million rubles into operation this very year; this will include a significant quantity of residential buildings and social, personal, and cultural institutions in our young city.

To me, a veteran of the gas fields of Siberia, it is pleasing to see how enthusiastically and resolutely Urengoy's laborers are working on the targets of the 11th Five-Year Plan. The collective of the first facility, in the launching of which I was able to participate less than 3 years ago, produced 100 million cubic meters of gas in excess of the plan since the beginning of the year.

11004
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SURGUT-POLOTSK OIL PIPELINE FINISHED

Minsk SOVETSKAYA BELORUSSIYA in Russian 28 Apr 81 p 1

[Article: "Hello, Siberian Oil!"]

[Text] The giant race of Siberian "black gold" has finished on Belorussian soil. Following the lead of enterprises in Perm', Gor'kiy, and Yaroslavl', Novopolotsk accepted Tyumen' oil today. This initiated full operation of the country's largest underground oil route from Surgut to Polotsk, 3,300 kilometers long.

The collectives of the city's enterprises prepared to meet the Siberian oil beforehand. As workers of the Ministry of Construction of Petroleum and Gas Industry Enterprises finished the last 300 kilometer section of the pipeline, they subjected it to testing in stages, thus making it possible to finish preparation of the pipeline for receipt of the raw material ahead of schedule.

This victory was the result of the joint selfless labor of Soviet and Polish specialists. Workers of the "Energopol" company made their worthy contribution to erection of the petroleum artery.

Commissioning of the oil pipeline will fully satisfy the crude oil demand of refineries in Belorussia and in the Soviet Baltic republics, and it will have a significant influence on further economic development of the region.

A triumphant meeting was held in honor of the arrival of Siberian oil in Novopolotsk. Speaking at it, refinery senior operator Hero of Socialist Labor A. S. Kozlov said:

"Accepting oil from faraway Tyumen today, we cannot but recall that time when the first batch of Belorussian gasoline was obtained from the refinery's sole facility. Eighteen years have passed since that time. The refinery has transformed into the country's largest oil processing enterprise, and it gave birth to a new city, and the largest chemical combine. Now that Siberian oil will undergo processing here, the facilities and the plant as a whole will operate stably for sure. We have a great wish to receive and refine tens of thousands of Surgut oil in excess of the plan in honor of the international May Day holiday."

Other speakers at the meeting were the construction director for the Andreapol'-Polotsk pipeline section--"Energopol" company's Khenrik Kubskiy, and installer Zbignev Levandovskiy. V. D. Chernyayev, chief of the "Transneft'" Main

Administration, handed a flask of Siberian oil over to the operators. Soviet and Polish specialists were congratulated by S. M. Shabashov, first secretary of the Vitebskaya Oblast committee of the Belorussian Communist Party, on their labor victory.

Belorussian Communist Party Central Committee Secretary Yu. B. Kolokolov was present at the meeting.

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MOSTOVSKIY THERMAL WATERS USED IN FARMING, ANIMAL HUSBANDRY

Moscow PRAVDA in Russian 12 Mar 81 p 3

[Article by P. Shvetsov, corresponding member of the USSR Academy of Sciences, and I. Dvorov, candidate of geographical sciences, deputy chairman of the scientific council of the USSR Academy of Sciences on geothermal research: "Not Only Greenhouses: How 'Thermal Waters' Operate"]

[Text] It all started from a small instance. In 1964, in the environs of the Mostovskiy settlement, the geologists drilled a well that revealed hot water instead of oil. It was later discovered that the region generally had rich reserves of hot water in the depths. At a depth of 1,500-1,600 meters there are layers of self-flowing, slightly mineralized thermal waters with a temperature of 75 degrees. The output of one well is up to 3,000 cubic meters per day. Then the idea occurred of the complex use of this unique energy raw material.

The Mostovskiy rayon of the Krasnodarskiy kray was set up in 1975. A. Kuyemzhiyev, a power engineer by education, and a pioneering and active man was then elected the first secretary of the party raykom. He focused attention on thermal waters that could be used with great effectiveness to intensify agricultural production, especially to make greenhouses. Back in August 1975, 7 kolkhozes on quota payments (737,000 rubles), set up the interfarm association "Plodoovoshchevod." The agronomist I. Asmolov was appointed its director. Two hectares of spring-film greenhouses were constructed by an economical method. They were heated by thermal waters. That same year, 162,000 rubles of profit were obtained from the results of one harvest alone.

We recently visited this farm. The first striking feature is large white tents stretching next to the settlement. These are the glass-and film-covered greenhouses. In the settlement itself, not far from the CPSU raykom building there is a low round brick structure with a door but no windows.

"This is our 'boiler house'," jokes the raykom secretary V. Fedyanin who just recently replaced A. Kuyemzhiyev who transferred to different work. "This is the geothermal well."

The association today has already become multisector. In 5 years, the enterprises of the Ministry of the Gas Industry have drilled and started up new wells. This allows 12 hectares of spring-film and 6 hectares of winter greenhouses to be heated. The association currently employs about 500 people. The cost of the main production funds has risen to 4 million rubles. In 1980 alone, 2,200 tons of vegetables were grown and over 1.5 million rubles of profit were obtained.

Business has been set up here so that the maximum use is made of the heat in the waters. The thermal water from the wells heats the greenhouses. The spent but still hot water with temperature of 45-50 degrees is sent to the livestock complex, the cow barns, pig sties and chicken coops. In the cold season, it heats the drinking water and is used to prepare feed and for washing. For example, pipes with hot water pass under the floor of the pig sty and the floor is always warm. This is very important. The young stock is excellent and the daily weight increases of the pigs is much higher than in standard pig sties. Good results have been attained in raising chicks. The production of poultry meat on the same area has doubled in a short time.

The warm water with a temperature of 25-30 degrees is further sent to the settling tanks and is then used for warm irrigation of the fields. This noticeably improves the productivity of the agricultural crops.

After the association "Plodoovoshchevod," the communal services of the settlement were connected to the wells. A significant number of the administrative and residential buildings of the rayon center are now heated and the population is supplied with hot water from the thermal resources. This is altogether 200,000 square meters of area and 6,000 residents. The boiler houses have been eliminated. There is no need to fell and transport large quantities of wood. The thermal waters are also used for technological purposes: for drying wood at the furniture kombinat, preparing mixed feeds, producing concrete, washing wool that comes from the entire region. A shop based on thermal waters has been set up to tan hides.

The association has a great outlook in the 11th Five-Year Plan. By 1985 it is planned to build another 15 hectares of winter, and the same number of spring-film greenhouses. Then the association will be able to grow over 11,000 tons of vegetables per year. The director, I. Asmolov, dreams of building 15-20 hectares of lemon groves. On winter days they can be heated with the water that is used in the greenhouses.

"Of course, the lemon groves will not yield a profit for 3 years," he notes. "But we have floating resources and they have to be invested with a thought for the future. In 3 years we will begin to reap harvests of lemons and oranges. We will also begin to grow flowers: happiness for the people and income for the association. In a word, we have big plans, however they are quite real, and what is important, they have the support of the party and economic organizations of the kray.

The scientific council of the USSR Academy of Sciences for geothermal research, jointly with the association "Plodoovoshchevod" plans to hold a school in 1981 in the Mostovskiy settlement on the subject: "Study of Geothermal Resources and Their Use for National Economic Purposes." Specialists from different regions of the country who have a relationship to this problem will be involved in it. They will graphically see, in a specific example, what a complex use of thermal waters can yield, and they will draw practical conclusions for themselves.

In order to provide a city of 100,000 residents with vegetables year round, it is necessary to have a minimum of 20 hectares of greenhouses. In the regions of the country's middle zone, this farming would require the same amount of heat that is consumed for daily and communal needs of the entire city. At the same time, the Mostovskiy experiment graphically proves that the expenditures can be considerably reduced by the extensive use of geothermal waters. It is no wonder that it is now being taken up by other regions of the Krasnodarskiy kray. A considerable saving of capital investments and a lower net cost of the vegetables are achieved simultaneously.

We have many regions that are rich in thermal waters. These are the North Caucasus and Transcaucasus, South Ukraine, republics of Central Asia and Kazakhstan, West and East Siberia, and the Far East. But this renewable energy of the depths is still used very little. The explored reserves of thermal waters only comprise 3% of the detected, predicted resources. Their involvement in the economic turnover is still based on enthusiasm and does not yet have a national, planned nature. But often activity alone is not enough for success.

For example, the city of Groznyy literally "floats" on thermal waters. In the search for oil, hundreds of wells were drilled here. A considerable number of them discharge water with a temperature of 85-110 degrees. Professor G. Sukharev and his students have been haunting the thresholds of the economic organizations of Checheno-Ingushetiya for a long time with the suggestion that the populated areas, greenhouses and livestock complexes be heated and supplied with hot water by using the deep heat of the earth. A method has been developed for artificial replenishment of the thermal water reserves for heat supply to Groznyy. Nevertheless, the plan is moving slowly.

The Main Directions adopted at the 26th CPSU Congress provide for an expansion of the greenhouse facilities, especially with the use of thermal wastes of industrial enterprises and thermal waters. Consequently, it seems to us that it is hardly expedient to permit greenhouses to be built with boiler houses in the regions where there is slightly mineralized thermal water.

These measures will accelerate the development of the enormous reserves of the earth's deep heat, will reduce the capital expenditures for construction of greenhouses, will diminish the cost of year-round production of vegetables, and will help to satisfy the population's demand for them more rapidly and more completely.

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FUELS

WINDMILLS USED IN ASTRAKHAN TO PUMP WATER

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 13 Mar 81 p 2

[Article by A. Kuchushev, engineer: "Energy of the Fifth Ocean"]

> [Text] "Increase the scales of use in the national economy of renewable sources of energy (hydraulic, solar, wind and geothermal)." (From "Main Directions of Economic and Social Development of the USSR for 1981-1985 and the Period to 1990")

Among the reports of the 26th CPSU Congress there is this one: on the Kazakhstan virgin soil, the Astrakhan plant "Vetroenergomash" shipped out a batch of wind engines "Tsiklon-6" ahead of schedule. They will be installed on distant range pastures.

As soon as spring rouses the steppe, thousands of flocks of sheep will move over it. Wells are prepared in advance for them. Pumps operating from wind units will lift the water from them. Each "windmill", operating in an automatic regime will supply fresh water from the underground wells for 1000 sheep. They replace the gasoline engine that it was always hard to supply fuel for.

Several "Tsiklons" have begun to operate in the farms of the Karagandinskaya Oblast. Three large livestock farms do not have to worry about maintaining watering places. These duties have now been adopted by the specialists of the trust "Soyuztselinvod." They are responsible for the continuous operation of the mechanisms. The output of the engines is increasing each year, and in addition to everything else, this conserves many tons of fuel.

"There is an enormous demand for our product," notes the wind power engineer V. Rad'ko. "The geologists and meteorologists, the gas workers and the land reclaimers would like to acquire the 'windmills.' But it is still difficult to satisfy all the orders for the plant is the only one in the country."

It manufactures low-speed "windmills" with vane spread to 6 meters. This unit lights up meteorological stations, polar stations or turns a pump for an artesian well.

The "windmill" has been changed in design of course. The openwork framework is mounted on a platform at computed hours and the adjustment for the wind does not require human participation for all the processes have been automated.

In "Tsiklon," an association for wind power engineering, they are considering how to expand the range of application of the "windmills." Many people have probably seen the power transmission lines above the gas pipelines. They provide a current to protect the pipes from corrosion. But at the same time they are harmful to migrating birds. A "windmill" has been installed to protect the pipeline from rust. The birds have stopped dying and the pipes are whole.

The reserves of wind energy are enormous. They are a hundred times greater than the power of all the power plants. But how can they serve the national economy?

The association "Tsiklon" recently set up a complex research section. This is what the famous designer of wind engines, USSR State Prize laureate, V. I. Sidorov relates:

"Long-term research was started back in the years of virgin land development. Then in the sovkhoz "Novoishimskiy" of Tselinogradskaya Oblast, a wind power station with output of 400 kilowatts was successfully set up. Twelve direct current generators supplied light through a transformer for three sovkhoz settlements.

The virgin land was an excellent school for the designers. Those advances of domestic wind power engineering that permitted a close approach to modern technical solutions passed verification right here. For example, then it was still impossible to do without the so-called heat reserve, that is, without diesel generators in case of still air. In the course of persistent experiments in the "Tsiklon" association, a draft for an original wind-hydrogen station that does not require organic fuel and constantly feeds a current to the network was implemented and verified in details."

Vladimir Iosifovich Sidorov is one of the few specialists who have remained true to wind power engineering all their lives. Even now "luminiferous" engines of his design are encountered everywhere, beyond the Polar Circle, in Karakumy, in the virgin land, in Siberia and in the Far East. What does the new project promise?

The areas of application of the wind-hydrogen units are fairly broad. They are irreplaceable in the northern regions of difficult access, on the swampy elevations where it is not profitable to ship fuel. At the same time, the output of the station equals the output of an average thermal station, 40,000 kilowatts.

Wind, wind! You are mighty. Continuing the poetic lines, we add: the purpose of wind is to move technical progress and help mankind.

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FUELS

DEVELOPMENT OF ASTRAKHAN GAS CONDENSATE COMPLEX BEGINS

Moscow IZVESTIYA in Russian 12 Mar 81 p 1

[Article by A. Chemonin, in-house correspondent of IZVESTIYA: "Birth of a Complex"]

> [Text] "Start to form an industrial center for extraction and refining of gas and condensate, as well as for the production of sulfur based on the Astrakhan gas condensate field."
>
> (Main Directions of the Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990).

Since school years we have been familiar with the "broom" of the Volga delta. Now I see it from a helicopter. The spaces are cut by innumerable twisting canals, branches, rivers and rivulets. It is strange that there is so much water, and such lifelessness nearby. Only on the edge of the shores are there narrow lines of bushes, and rarely, trees. Between them there is sand and more sand.

The oblivion of these steppes has ended. In the last five-year plan, a sparse forest of exploratory drilling derricks rose up here. In the 11th, by decisions of the 26th Party Congress, an unheard of scale of construction is planned. Everything will liven up here and begin to hum. The exploratory drills of the geologists have felt yet another field under Astrakhan. Only it is made of a fuel mixture called gas condensate. Its reserves are still being pinpointed, but it is already clear that they have industrial value. This is not the only advantage of the Astrakhan discovery. It is the quality and the composition of the gas condensate. Usually plants are built to distill the crude oil into fuel for carburetor engines. In the Astrakhan depths, in its natural furnaces, the crude oil has seemingly passed part of the process of distillation. Yesterday's "Pobedy" would have operated on Astrakhan gas condensate with great pleasure. It can be pumped from the depths directly into the gas pump. Today's automobile motor is more productive and more demanding for the octane number of the gasoline. Even so, the profitability of the Astrakhan gas condensate field promises to be high.

The field is unique in the composition of useful petroleum products. A large part of the reserves consists of sulfur. It is known that gas sulfur is the most chemically pure. It is valued very highly on the foreign market. There is a lot of pure carbon dioxide here that could be used in cooling units, and could also be pumped back into the depths to increase the bed pressure. The field is conveniently located in relation to the transportation mains. It is intersected by railroads and car roads, the Volga and the Caspian. The Don and Ural Rivers are nearby and the Black Sea is close. Finally, the desert and oblivion in the past of these places seemingly worked in favor of the 11th Five-Year Plan. Nothing has to be cut or reconstructed as occurs in similar cases. The Astrakhan steppe is like a clean sheet of paper. Here everything starts from zero. The planners, economists and especially the architects dream of these conditions. It can be developed.

In the fiscal report of Comrade L. I. Brezhnev at the 26th CPSU Congress, the basic instructions were formulatad regarding the use of fuel and energy resources, including oil and gas. In particular, a requirement was made to improve the structure of the fuel and energy balance. Two of these aspects determine the nature of the future industrial center.

The field stretches from the center of Kalmykiya in the west and enters the Kazakhstan steppes in the east. What has already been explored is of great industrial interest. The area that has been explored is in the very top of the so-called Astrakhan arch: This means that there is a margin of safety here. These are kilometers of land that are absolutely filled, if not with pure condensate, then in any case with the necessary satellites, including sulfur. The Main Directions speak of the need for the most rapid industrial extraction of them. It is also important that powerful formation pressure is available, 630 atmospheres. This means that the net cost of both the condensate and everything accompanying it will not be too high. They will not have to be pumped out, they will escape to the surface by themselves.

"What needs to be built here?" I ask the head of the department of the Scientific Research Institute of Geology and Geophysics, N. Voronin.

"The main construction tasks have already been formulated by the Main Directions: extraction and refining of the gas and condensate, one, production of sulfur, two. This means, first of all, a gas refinery of large output. It will separate the fractional composition into gas and liquid and will separate the sulfur from them. The specialists will decide where the gas and condensate are sent to. These are our suggestions: pump the condensate to Groznyy where there is an active industry capable of refining the condensate of similar fractions accompanying oil. The gas is needed in Astrakhan itself, Volgograd and Saratov. The planning agencies should take into consideration the instruction of the 26th Party Congress regarding the need to reduce the percentage of oil as a fuel and replace it with gas, and to send it where it is most needed."

The first secretary of the Astrakhan obkom of the CPSU, L. Borodin told me: "I would like to provide everything reasonable that would satisfy construction and would conserve natural resources. It remains to develop the production of local construction materials, construction of a gas refinery and a large pipeline network, sources of electricity and lines to transmit it on, and new railroads. Finally, the most important is housing. We are concerned about the compensation fishing facilities and other environmental protection measures."

At the field, I conversed with the head of the geological department of the oil exploration expedition, M. Kalimulin, the head of one of the sections, V. Subbotin, and the remarkable driller, the bearer of two orders, A. Sinel'nikov. All of them spoke of the need for competent arrangement and good planning of the housing. If in the first place comfortable housing is built and the daily life of the oil and gas workers is well-organized, it will be easier to work, the labor productivity will be higher and the problems that are now very large and difficult will be resolved more quickly.

The main point is to give oneself passionately and in a communist manner to the job, to advance it with the foresight of a zealous master, from the first steps link practice to the achievements of science, and act energetically, economically and efficiently. This is how our party teaches us. "The core of the economic policy is becoming a matter that is seemingly simple and very prosaic, a thrifty attitude twoards the public good, and the ability to completely and efficiently use everything that we have," thus spoke Comrade L. I. Brezhnev at the congress. "The initiative of the labor collectives and the party-mass work must be aimed at this," he stressed. "The technical policy, the policy of capital investments, and the system of planning and accounting indicators must be aimed at this." This must be the beginning of the "clean sheet" in the Astrakhan steppe, this is what my interlocutors thought.

These are the requirements of the 11th Five-Year Plan that is turned towards the future 21st century. The people of Astrakhan, the drillers, oil and gas workers are thinking about this. There is no doubt that by 1985 the Astrakhan gas-condensate complex will be put into operation. But it must begin its life as one of the most modern, adjusted and efficient industrial centers.

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FUELS

SHORTCOMINGS, PROBLEMS AT AZERBAIJAN INSTITUTES NOTED

Baku BAKINSKIY RABOCHIY in Russian 1 Mar 81 p 4

[Article: "Commissions at Work"]

[Text] The accountability report at the 30th Congress of the Communist Party of Azerbaijan posed the challenge of activating work in the field of exploration of new petroleum and gas deposits and exploiting the resources of existing wells more efficiently. To bolster the help given by science to production the Commission on Public Education and Science and the Commission on Industry of the Supreme Soviet of the Azerbaijan SSR held a joint meeting under the chairmanship of deputies I. A. Ibragimov and T. D. Akhundov, at which they discussed the work of the institutes of the Azerbaijan SSR Academy of Sciences on problems related to the development of the petroleum industry and practical introduction of scientific results. F. M. Bagiradze, head of the deputies' preparation group, presented information on this question.

The report noted the major contribution of institutes of the Academy of Sciences to studying the geological structure and patterns of formation and location of hydrocarbon deposits, determining promising areas for petroleum and gas exploratory and operations work in the republic, and solving applied problems of petroleum and gas extraction.

At the same time, this communication and statements by deputies F. D. Rustanbekova and V. I. Guliyev, the managers of the Azerbaijan Petroleum and Caspian Sea Petroleum-Gas Industry associations, and the directors of scientific research institutes mentioned a number of unsolved problems. The institutes of the republic Academy of Sciences are not making full use of existing opportunities to raise the level of scientific and applied research, which includes studies of problems of the development of the republic petroleum industry and introducing completed projects into production. The results and effectiveness of geological-geophysical and prospecting-exploration work for petroleum and gas on land and at sea are not subjected to systematic critical analysis.

Work to bring each new scientific development to the stage of introduction needs improvement. The institutes of geology and problems of deep petroleum-gas deposits do not have up-to-date experimental facilities, which has a negative effect on scientific research. The coordination of scientific research work must be refined.

The Commission on Public Education and Science also reviewed the situation with preparation and publication of textbooks for the Azerbaijan Pedagogical Institute imeni V. I. Lenin. In their statements T. K. Kocharli, head of the deputies' preparation group, and commission members Dzh. B. Guliyev and Kh. T. Guseynova noted that students at the republic's largest teachers college do not have adequate texts.

Other higher and secondary specialized educational institutions in the republic are also experiencing a shortage of textbooks and materials. Whereas the demand for such material is growing each year, the publication plan is declining.

The commissions adopted appropriate decrees on the issues under discussion.

S. A. Rustam-Zade, chairman of the Supreme Soviet of the Azerbaijan SSR, and R. S. Kaziyeva, secretary of the Presidium of the Supreme Soviet of the Azerbaijan SSR, participated in the work of the commissions.

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FUELS

OIL WELL OUTPUT INCREASED

Baku VYSHKA in Russian 1 Apr 81 p 2

[Article by Correspondent S. Bagdiyan: "In Defiance of the Difficulties"]

[Text] As the oilmen of foreman Alishan Akhmedov's team expected, the calculations for well No 792 were right. After its development, it began producing oil from the upper formation of the Kirmakinskaya series with a daily output of a ton and a half. This was the first well that Petroleum and Gas Extraction Shop No 1 of the "Azizbekovneft'" Petroleum and Gas Extraction Administration brought back into production in January following a long period of idleness.

This result is good, if we consider that the fuel yield from most existing wells barely reaches a ton a day, and that the productive stratum itself has been under development for about 5 to 10 years. During this time the stratum has become considerably flooded, the strength of exploitation well shafts has decreased, and plug formation has increased. But despite the difficulties the workers of the shop, headed by Communist Museib Asadov are successfully fighting to stabilize the fuel yield. Supporting the initiative of Shirvanskoye oilmen, who suggested a socialist competition with the slogan "A maximum payoff from each well", oilmen of Shop No 1 managed to extract 500 extra tons of petroleum last year from the old grounds. This success was achieved mainly through competent work with the existing fleet of wells.

"Inspired by decisions of the 26th CPSU Congress and the 30th Congress of the Communist Party of Azerbaijan," explained oilfield director M. Asadov, "our collective and all of the administration's laborers pledged to preserve the attained level of fuel extraction until the end of the 11th Five-Year Plan. The results of the first 2 months persuasively demonstrate what can be achieved when we work persistently and creatively. Take as an example well No 1485. It worked normally, and it supplied 1.2 tons of petroleum per day. Together with senior geologist Ismail Veliyev, foreman Yunus El'darli analyzed the analysis data and the logging diagram, revealing a small productive peak within the same formation. A decision was made to perforate the well within this interval. And so, what happened? After this step was taken, the oil output of well No 1485 doubled."

A search--a daily one at that--for reserves with which to raise well productivity may insure successful stabilization--such is the opinion of foreman El'darli himself and of the best operators of the team--Bayram Atayev, Rakhman Atakishiyev, and Mirfatakh Agayev. These workers, who have 20-25 years of experience behind their backs, feel a personal stake in production, and they serve as an example of a conscientious attitude toward the work. There are good reasons why the team collective has been able to deliver 37 tons more oil than planned since the beginning of the year--more than any of the other three teams. The team was awarded the Honorary Certificate of the USSR Ministry of Petroleum Industry for its shock work in the precongress competition.

Teams led by foremen Rafik Alkhozov and Nikolay Vdovenko are successfully reaching their oil extraction targets. Within their areas of responsibility, three inactive wells will be placed back into operation by the end of the second 10-day period of March. At one of these wells, No 706, overhaulers sunk a new shaft into a projected horizon of the sub-Kirmakinskaya series with the help of recutting and redrilling. Preparations are now being made for perforation of the well. The oilmen expect not less than 3-4 tons of fuel per day from it.

"In order to maintain the extraction level, in addition to completing the jobs mentioned above, together with workers of the scientific research and production shop we have broadened our front of water injection into the formations," said senior geologist I. Veliyev.

A cluster of four wells is responding in the second horizon owing to the effect of injection well No 732, placed into operation at the beginning of the year.

Positive results in efforts to improve the permeability of the critical zone of the wells were achieved by pumping in surfactant solutions and corrosion inhibitors. These measures made it possible to increase the time of well operation between repairs, and the operating life of underground equipment. Last year many dozens of compressor hoses and pipes were saved in more than 20 wells, into which corrosion inhibitor was pumped.

These and many other factors permitted the laborers of the shop to satisfy their precongress pledges ahead of schedule, and extract 70 more tons of petroleum than planned since the beginning of the year.

The shop collective has pledged to increase its extra fuel extraction to 220 tons by the end of the year.

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SHOP IMPROVES OIL EXTRACTION

Baku VYSHKA in Russian 1 Apr 81 p 2

[Article by I. Osmanov, assistant chief, Shop No [illegible], Production Association for the Extraction of Petroleum and Gas imeni XXII s"yezda KPSS: "The Potential of the Bed"]

[Text] The collective of our Petroleum and Gas Extraction Shop No 4 made a worthy contribution to the labor victory won by the laborers of Neftyanyye Kamni in the all-union socialist competition last year. About 12,000 tons of petroleum were extracted in excess of the plan under complex offshore conditions. Such a high increment made it possible to stabilize the level of extraction of fuel from the oilfield's formations.

This success was promoted to a considerable extent by a competition at the oilfield for maximum productivity of each well; as we know, it was initiated by foreman A. Nasirov's team of the "Shirvanneft'" Petroleum and Gas Extraction Administration. Experience and knowledge acquired over a period of many years were used to achieve fuller utilization of our petroleum extraction reserves.

We place our main emphasis on engineering and geological work. This approach is predicated mainly by the condition of the southwest wing of the Neftyannye Kamni oilfield, development of which began before that of other formations in this region. The lower strata are severely depleted, and they have been flooded to a significant extent. Moreover this process entails disintegration of the critical zone, which elicits abundant transfer of sand to the well heads.

The fight against sand plugs is being conducted by various methods at the oilfield. The teams of foremen Nasretdin Kerimov, Abbas Gasymov, and Muslimbek Isabekov strictly monitor the condition of the wells, and they promptly replace flow regulators, and pump water through for preventive purposes. This is a routine and, at first glance, a simple matter, and it is a dependable reserve for increasing the oil output of the bed.

Concurrently with this, industrial purging blocks were installed in the last 2 years in 12 areas containing low-yield wells. A self-contained oil collecting and pumping system eliminates counterpressure in the bed and improves the operating conditions of the wells.

But well organized well maintenance is only half of it. Implementation of a broad complex of geological and technical measures is helping to maximize production.

Take as an example well No 1520. Geologists turned their attention to a series of discontinuities, an intercalation of small thickness, which from all signs contained oil. The site was perforated, after which operators Georgiy Chernysh, Mezhvetdin Alimardanov, and Rachik Grigoryan developed it according to all of the rules. As a result the well turned into a gusher, producing 40 tons of oil per day.

Natural flooding of the formation forced us to reexamine our approach to many of the facilities, and seek the reserves more persistently and purposefully. An example of this can be found in well No 1692, in which water "tongues", as they are called, "licked" the lower stratum clean. We first considered converting it into an injection well, but after carefully analyzing the geological material we arrived at the idea of testing out the Kirmakinskaya series. This is what we did. And now with the aid of a compressor, well No 1692 is supplying 7 tons of oil per day.

The great tasks posed before the Soviet people by the 26th Congress of our Leninist party elicit a feeling of pride for one's country and an influx of new creative strength in every laborer, foreman, and engineer. The shop collective honorably fulfilled its precongress pledges, and more than 2,000 extra tons of oil entered the reservoirs in 3 months of the present year.

But this is not the limit for us. Leonid Il'ich Brezhnev's words about economy, about a thrifty attitude toward national wealth, encourage all of us to make fuller use of the existing reserves.

Moreover we have many possibilities for improving our work. Take as an example the delivery of compressed agent to the wells. In the cold part of the year, liquid accumulated in some places of abrupt pressure gradient; this liquid transformed into hydrates. Electric heating units installed at the sites prevent their appearance. But this does not solve the problem completely. Formation of hydrates occurs in the bends of main pipelines, resulting in certain interruptions in the work of the wells. In my opinion this problem could be solved by improving compressed gas purification and dessication at the compressor stations.

Our shop collective is laboring with special inspiration today. Implementing the historic decisions of the 26th CPSU Congress, the field's oilmen are trying to work even better, more productively, and to reach new, higher summits.

11004
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WORK OF ESTONIAN GEOLOGISTS IN 10TH FIVE-YEAR PLAN DESCRIBED

Tallinn SOVETSKAYA ESTONIYA in Russian 5 Apr 81 p 1

[Article by A. Kivit, head of the Administration of Geology of the Estonian SSR Council of Ministers: "Always on the Way"]

[Text] In the 10th Five-Year Plan the Soviet geologists did considerable work to provide a stable material and raw material base for the country's industry and agriculture, environmental protection, and for purposeful use of natural resources, secondary resources and wastes of the minin[illegible] [illegible]d refining industry.

The Estonian geologists have also done a lot. Accord[illegible] the results of preliminary exploration of the southern part of the Eston[illegible] shale field, their technological and economic study, and investigation [illegible] ning-geological and mining-technical conditions, the expediency was conf[illegible] involving shale into production with caloricity from 1450 kcal/kg of rock. [illegible] ill increase the real reserves of fuel shales in limits of 1.8 billion [illegible] and afford a broad outlook for the industrial use of fuel shales of the [illegible] a field.

As a result of this, the problem of reducing the use of oil and peat as fuel and energy raw materials and their replacement with local low-calorie types of fuel, in the given case, fuel shales, will also be successfully resolved. The work that has been done not only drastically curtails the losses of fuel shales in the depths, but also considers the real provision of the republic with reserves of fuel shales for 100 years. Now the geologists are faced with continuing the study of the outlook for the possible increase in fuel reserves based on dictyonema shale and lower calorie fuel shale.

An economic evaluation was made in the 10th Five-Year Plan of the natural resources in the shale open pit "Oktyabr'skiy" of the "Estonslanets" association, and the resources of underground water in the active water intakes. The calculations demonstrate that it is economically justified to extract shales with destruction of the land, despite the great expenditures for recultivation of the latter for further use as farming land.

The republic geologists have compiled a long-term plan for extraction and use of peat in Estonia to the year 2000. They have calculated the peat reserves within the shale open pits of Viyvikonn and Sirgal for their complex use when fuel shales are extracted. Work has been completed to predict and make a geological-economic estimate of the agrochemical resources in the republic.

A lot of work was done to explore the construction materials, underground and mineral waters, as well as for hydrogeological and engineering-geological preparation and study of areas for melioration of water-logged territories and farming lands.

An inventory was made of the water intakes and sources of pollution of underground waters of the Kokhtla-Yarve and Payde regions. Peat reserves were explored on the Keressaare, Keava, Kyrsa and Laykyula fields, limestone on the Padise-Paemurrud and Kharku fields, facing dolomites on the Kaarmaa field, sand on the Sillaotsa field, and others. A resource map was compiled for the republic for all types of mineral raw materials. It is the basis for their efficient use.

In order to achieve these results, considerable volumes of scientific research, thematic, geophysical, geochemical, technological and economic studies and drilling work were done. During the 10th Five-Year Plan, over 300,000 meters of wells were drilled, or 17.8% above the plan. The plan for labor productivity was fulfilled by 113.5%, the profit plan by 108.6%, and introduction of new equipment and technology by 122%.

The Kokhtla-Yarve geological party, the Keyla geological expedition and the Estonian hydrogeological party became the winners in the all-union and republic socialist competition in the 10th Five-Year Plan. The drilling brigade of I. Spasyenov fulfilled the five-year plan in October 1979 and the brigade of A. Raamat in August 1980. On the whole, the collective of the Administration of Geology of the Estonian SSR fulfilled the assignments of the 10th Five-Year Plan and their socialist commitments ahead of schedule. The name of the driller of the Kokhtla-Yarve geological party, E. Kolosov, was hung on the all-union honor board at the USSR VDNKh [Exhibition of Achievements of the USSR National Economy], and the names of V. Yurgenson and V. Basanets were entered into the book of honor of the ESSR Administration of Geology.

The Estonian geologists are faced with large tasks in the 11th Five-Year Plan. The chief ones are to provide the mining enterprises and branches with a sufficient quantity of minerals, and the national economy with underground water, to efficiently use and protect the depths, to protect the underground waters from depletion and pollution, and to study the continental shelf of the Baltic Sea.

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FUELS

GASOHOL PRODUCTION JUSTIFIED

Tbilisi ZARYA VOSTOKA in Russian 24 Mar 81 p 2

[Article by G. Kvesitadze, head of laboratory of enzymes of microorganisms of the Institute of Plant Biochemistry of the Georgian SSR Academy of Sciences, doctor of biological sciences: "Fuel from Wastes"]

> [Text] Taking into consideration the quite visible oil reserves, in the last 15-20 years all possible searches have been made to replace gasoline as a fuel , or to create new types of engines on completely different bases.

The most promising results in this respect were obtained in the attempt to use ethyl alcohol as a partial or complete substitute for gasoline. In the opinion of the specialists, a more real solution of the problem of obtaining fuel for cars in the very near future will be the use of gasohol, gasoline that contains added ethyl alcohol.

Starch or cellulose-containing raw material is usually used to produce ethyl alcohol (both food and technical grade). As a result of fermentative or acid hydrolysis of these products glucose can be obtained. Its fermentation results in the formation of ethyl alcohol. The main industrial sources of starch in the USSR are wheat, corn and potatoes. Nevertheless, for a number of reasons, it is now inexpedient to use starch as the source of ethyl alcohol. It is natural to ask whether there are other sources for obtaining it? Yes there are. A large percentage of the world's reserve of cellulose is concentrated in our country. Its wastes comprise a million tons and even now have not found practically any industrial realisation.

Speaking at the 26th CPSU Congress, General Secretary of the CPSU Central Committee, Comrade L. I. Brezhnev did not accidentally note that "... the core of economic policy is becoming a matter that is seemingly simple and very prosaic, a thrifty attitude towards the public good, and the ability to completely and efficiently use everything that we have."

Calculations show that our country has truly enormous reserves. A high economic effect can be obtained if they are protected. One of them is the maximum use of wastes from different branches of the national economy.

Hydrolysis of cellulose to the composite monomer, glucose, is currently done by two methods: acid hydrolysis and biological method, by special enzymes called celluloses. The method of biological degradation of cellulose that consists of hydrolytic splitting of the substrates by enzymes has a number of real advantages as compared to acid hydrolysis. Its use does not require the employment of expensive thermo- and acid-proof equipment. The hydrolysate does not contain undesirable products, furfural, and residues of sulfuric and hydrochloric acids. The advantage of the fermentative method of splitting cellulose is that it becomes possible to directly use the formed glucose in the process of feeding animals and people.

The products of chemical and microbiological conversion of cellulose can have exceptionally extensive use in a number of the most important branches of the national economy. The value of the obtained products is considerably increased if one considers that the cellulose suggested for fermentative hydrolysis is a waste product of a number of industrial sectors.

In the USSR, the main cellulose substrates are wastes of the wood processing industry and wastes of cotton production that comprise hundreds of thousands of tons. Among the other potentially important cellulose substrates one should isolate the wastes of agriculture, the food industry and other wastes. Hundreds of billions of tons of cellulose are formed annually merely as a result of photosynthesis. All of this indicates that cellulose is the most widespread and annually renewable organic compound. In the near future it will apparently be one of the main sources of energy, much more stable than oil or natural gas.

Thus, the development of the technology and detection of the potentialities of producing inexpensive ethyl alcohol, glucose and other valuable products from cellulose is an exceptionally important task of national concern. The scientists must make a weighty contribution to solving this problem. The Institute of Plant Biochemistry of the Georgian SSR Academy of Sciences has begun developments to create the technology of biodegradation of cellulose into glucose with its subsequent fermentation into ethyl alcohol.

The success of the matter will be promoted by the peculiarity of certain cellulose substrates that can be obtained in the republic. They include wastes and secondary raw material of grape processing products, wastes of the canning industry, pressed fruit residues, wastes of processing citrus and tomato products, tea and essential-oil production, etc. A feature of these cellulose substrates in contrast to the main sources of cellulose, lumber, cotton and different wastes, is that these substrates make it possible to obtain food glucose. In cellulose resources (we have in mind only the wastes of the food industry and agriculture), there is yet another advantage: the majority do not require the usually necessary, complicated and expensive process of delignification.

The biochemical scientists have already done a full cycle of work on bioconversion of cellulose that includes fermentation of glucose into ethyl alcohol. An economic evaluation has also been worked out for the net cost of glucose, ethyl alcohol and feed yeasts.

The new and important type of research whose implementation has been successfully started in the Institute of Plant Biochemistry, for the purpose of the most rapid introduction must be allowed in the form of complex work with the participation of a number of organizations: scientific research institutes and experimental bases of the ministries of agriculture and the food industry of the republic, and the Georgian and Kutaisi polytechnical institutes. The implementation of this type of work will to a considerable measure promote the creation of waste-free production in a number of industrial sectors of the republic.

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SHURTAN GAS-CHEMICAL COMPLEX BECOMES LEADER IN UZBEKISTAN

Tashkent PRAVDA VOSTOKA in Russian 27 Mar 81 pp 1-2

[Article by Yu. Kruzhilin, correspondent of UZTAG: "Silver Pipes of Shurtan"]

> [Text] "Consider the most important task to implement the program of forced development of natural gas extraction." (From the "Main Directions of Economics and Social Development of the USSR for 1981-1985 and the Period to 1990.")

The rain-washed emerald hills stride beyond the horizon like sea waves. The flocks are on the slopes with slow herdsmen. There is a fresh wind above the hills. Soon it will become hot. The grass will be brittle and yellow and the silvery metal of the pipes will burn the fingers.

But even now, under a fresh wind, these pipes are hot and dully hum from the pressure. The pipes are behind the modest enclosure, the plain manometer dial. There are ten of these enclosures on the hills. And that is all.

But look at the position of the arrow on the manometer.

It shows 350 atmospheres.

The incalculable wealth of Kashkadar'ya, the gas of the Shurtan field, bursts from under the ground under this enormous pressure. The main fuel and energy base of Uzbekistan is now being shifted here, to the environs of Karsha, from the Central Kyzylkumy. At the Gazli field that has been operating for over 30 years, gas extraction is declining, while here the geologists have already discovered reserves of almost half a billion cubic meters. And the exploration is successful and is continuing.

We arrived here at the moment when work was unfolding at the active Shurtan field in order to double the gas extraction this year. Instead of 4 billion cubic meters, 8 billion will be extracted from the heart every year.

This requires complicated work on vast spaces. First of all, another 10 wells, 2-3 kilometers deep each have to be drilled. Then pipelines must be laid from these wells to the so-called unit of preliminary gas preparation. Here the mechanical admixtures (stones, particles of sand) and valuable liquid product, condensate, are separated from the extracted fuel. The gas is then sent on pipes to other equipment from which the main gas pipeline starts. Here the gas is purified of the sulfur it contains, dried, and brought to the necessary temperature and pressure. After this, it is sent on a further route, hundreds of kilometers, where it is awaited.

This entire set of operations is going at full speed.

The drilling derricks have been installed on rounded summits, indicating the place where the brigades of the "Uzbekburgaz" association are drilling into the depths.

The trailers have arrived at the platform that has been cleared next to the active gas preparation unit. Equipment is unloaded from them, heavy tanks in which the process of condensate isolation will occur. As soon as the land gets a little drier, the installers from the ninth administration "Sredazneftegazmontazh" will begin assembly.

Next to the powerful, active complex of main structures of the Shurtan-Syrdar'inskiy GRES gas pipeline, yet another plant of gas purification has been built. The installers are putting the last equipment in place to absorb the sulfur contained in the gas, others in which the water vapor precipitates out, and others where the nececessary chemicals will be prepared for reactions.

The most complicated part of the job is ahead, "connecting" the installed equipment with dozens of kilometers of all types of pipes. The gas industry is first of all made up of pipes. The welder is the main figure in the construction of gas facilities.

The certified welders of "Sredazneftegazmontazh," having connected all the pipes in the first phase of the Shurtan field, have brilliantly coped with their task. This was not easy. The pipe on which the gas comes from the wells is similar in thickness of the walls and quality of the steel to a cannon barrel for it must withstand 350 atmospheres for years! High skill and strict technological discipline are required to weld these pipes. Control with the help of precision instruments, and then months of operation of the equipment did not reveal a single defect. Not a single butt joint faltered under the force of the deep pressure.

The collective of the ninth administration of installers have been obliged to conduct the next phase of work at the field with the same good quality and to finish it in the planned period.

At the same time, the planners, designers and builders of the all-union association "Soyuzuzbekgazprom" are preparing for a new step in increasing gas extraction in Shurtan. All that has been done here and still will be done before the end of the year, although it looks impressive, is only the beginning.

It remains not only to increase extraction several gimes, but also to create near Karshi one of the country's largest gas-chemical complexes. This gas has a complex composition. Even now, valuable fuel, condensate, is being extracted from it. Next is a plant for ethane production which will supply the chemical enterprises of Navoi with raw material for plastic production. In addition, propane-butane are isolated from the Shurtan gas. If it is put in a compressed state it can fuel cars and cylinders for supplying apartments.

After giving up such useful components, the Shurtan gas remains a highly effective fuel. There is enough not only for the Syrdar'inskiy GRES. Planning has already begun for a new main on which the gas from these steppes will also go to the Tashkent GRES. Other major consumers, the Akhangaran and Bekabad cement kombinats will also receive it.

All the participants in the work on the Shurtan gas-chemical complex are working precisely and coordinatedly. The ministers of the USSR chemical and gas industry have issued a joint order that defines the outlook, specific shedules for introduction of the facilities, and the mutual commitments of all the collectives of the enormous construction site. What has been planned is mainly being fulfilled, however, the local organizations, "Karshistroy" and the subdivisions of the Uzbek SSR Ministry of Construction have delayed the start-up of the water intake to supply the new enterprises,and housing for the gas workers. All of these are start-up facilities of last year, but they are not even ready today. It is necessary to hurry, the construction site cannot wait.

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FUELS

IMPORTANCE OF GAS DRILLING FOREMAN DISCUSSED

Ashkhabad TURKMENSKAYA ISKRA in Russian 22 Mar 81 p 1

[Editorial: "Drilling Foreman"]

[Text] The labor collectives of Turkmenistan, inspired by the historical decisions of the 26th CPSU Congress are persistently implementing the plans. One of the key economic tasks of the 11th Five-Year Plan is all-possible increase in the fuel and energy resources. As noted at the recent meeting of the active party members of the republic, the situation in the fuel sectors requires the special and steady attention of the party and soviet agencies in the localities, the economic leaders and all communists.

This is also made mandatory by the Main Directions for Economic and Social Development of the USSR for 1981-1985 and the Period to 1990. According to it, gas extraction in the Turkmen SSR must reach 81-83 billion cubic meters. It remains to increase the extraction of oil as well. For these purposes, work has to be expanded for exploratory and developmental drilling for oil and gas. Reserves of power engineering raw materials have to be sought and accumulated.

The collectives of drillers of the all-union production association "Turkmengazprom," the association "Turkmenneft'," and the Administration of Geology of the TuSSR have been called upon to solve important tasks. They are in the forefront of the battle for accelerated and efficient development of the gas and oil industry. At 60 structures that are promising for oil and gas and are located deep in Karakumy and the foothills of Keptedag, the first drillers are working. They must drill 736,000 running meters this year. But we are not only speaking of expanding the drilling front, but also the all possible increase in its efficiency, rise in rates and increase in the quality of labor with a reduction in material expenditures. High results need to be obtained through intensive methods of production. The commanders of the first link are given a decisive role in fulfilling this task.

The drilling foreman is the central figure in the exploration. The fate of the search, and in the final analysis, the replenishment of the country's fuel balance depend on his experience, knowledge of the equipment and technology, organizational and managerial capabilities, initiative, ability to join people, and to direct the collective energy to a true channel. The honorable and responsible duty of the drilling foreman is to guarantee the continuous work of the gas and oil extractors who live and work for a long time far from the population points, from the roads and production bases.

The motherland highly values the fruitful, selfless work of the Soviet people. For advances made in the 10th Five-Year Plan, the Turkmen prospectors, the head of the South Turkmen drilling administration of exploratory drilling V. A. Linichenko, the assistant driller of this same collective, V. F. Zhuravlev, the drilling foreman of the Achakskiy administration of drilling operations, L. A. Khazhgoriyev and others were awarded orders and medals of the USSR.

Bearer of the Order of the October Revolution, V. A. Linichenko and drilling foreman I. [illegible] of the all-union industrial association "Turkmengazprom," responding with work to the party's call to work better and more efficiently, picked up the initiative of the Moscow workers to fulfill the assignment for 1981 by 7 November. Zealous use of equipment, tools and reagents, discipline and organization permitted the leading brigades to increase the rates and quality of drilling.

The red stars on the boreholes of B. Batyrov and V. Shumskiy from the Administration of Geology of the TuSSR, A. Amanyazov and V. Sakhnov from the association "Turkmenneft'" serve as a standard for all the prospectors. The brigades of foremen Yu. Leont'yev and Z. Tsogoyev from the all-union production association "Turkmengazprom" who participated in the exploration and discovery of the gas fields of Bagadzha, Farab, Samantepe, Kirpichli and others have passed through over a thousand meters of rock in addition to the five-year assignment. The lack of standstills and complications permitted the collective of Yu. Leont'yev to accelerate the drilling of a super-deep well by 97 days on the area of South Unguz.

The party, trade-union and komsomol organizations of the administrations of exploratory drilling, the economic leaders are obliged to strengthen the valuable initiatives of the leading workers with specific, mass-political work, and to make their experience the property of all drillers.

The importance of this task is also governed by the fact that progressive drilling methods are not introduced into practice everywhere. As analysis shows, the average indicators in exploration differ sharply from that attained by the best collectives. In the association "Turkmenneft'" the gap is 1.6-fold, and in "Chelekenmorneftegazprom" it is 2.3-fold. Almost half of the brigades do not fulfill the plans.

An alarming situation has developed in the offshore exploratory drilling where there is an especially great difference in the results of individual mines. On many of the steel islands, because of low discipline, negligence, and violations by the drilling foremen of the drilling technology there are frequent accidents and complications.

The facts indicate that lack of attention by certain party organizations and managers to political-educational work among the drilling foremen, insufficient exactingness towards them, and low concern for the rise in their qualification and occupational skill result in the most undesirable results.

It is no accident that in the association "Chelekenmorneftegazprom" the production time in exploratory drilling is only 33%. Millions of losses have been recorded. During the entire 10th Five-Year Plan, the drilling subdivisions of the associations "Turkmengazprom" and "Turkmenneft'" operated unstably.

The main condition of success is to persistently follow the Leninist principles of selecting and training personnel, to strictly deal with the commanders of industry for interruptions in the state assignments and for violations of the labor and execution discipline. At the same time, it is necessary to improve the work and daily life of the prospectors of the depths and to guarantee continual assistance to the drilling foremen in attaining high final results. For these purposes, it is necessary to perfect the control and material-technical support of the brigades, to use the most effective forms of socialist competition and line methods of organizing major drilling operations.

It is no secret that slow increase in the operating fund of wells and increase in the fuel potential of the republic occur to a considerable measure because of a lack of coordination in the drilling conveyer. Quite often, interruptions are observed in the deliveries of pipes, spare parts and reagents. In looking for them the drilling foremen lose the lion's share of their time. Often the wells that are ready and were drilled at an accelerated rate stand for months waiting for testing. This nullifies the efforts of the drillers. There are unfortunately cases where the brigades are given the work front only after a delay.

The introduction of the line method of constructing wells, and socialist competition on mutual agreements between brigades engaged in a unified technological cycle, by example of the Al'met'yev oil workers must become a great help to the drilling foremen and the collectives as a whole. This experience is used somewhere, but narrowly, and therefore its efficiency is very low. Good organization of a useful and necessary job, the creation of coordinated drilling conveyer, is a task of statewide importance. The party, soviet and planning agencies, and the leaders of the associations, ministries and departments are obliged to resolve it by joint efforts.

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BRIEFS

NEW SHALE DEPOSIT--Kuremyae (Estonian SSR), 9 March (TASS). A region of major fuel shale formations was discovered by Estonian geologists not far from the northern shore of Lake Chudskoye. According to calculations of the experts, the reserves of this deposit are 1.5 billion tons. Fuel shale is now being used as a fuel in electric power plants, and in the acquisition of more than 50 types of chemical products. [Text] [Leningrad LENINGRADSKAYA PRAVDA in Russian 10 Mar 81 p 2] 11004

GASOLINE FROM COAL--Novomoskovsk (Tul'skaya Oblast), 12. A decision has been made to build a plant producing liquid products from coal near the new "Bel'kovskaya" mine. It was stated at the 26th CPSU Congress that there was extreme importance not only in the direct use of coal for power, but also in acquisition of liquid and gaseous products from it--gasoline, kerosene, and diesel gas turbine fuel. The Moscow basin has been given the honor of pioneering this new effort. The plant at the "Bel'kovskaya" mine is to become the experimental base. [By V. Shvetsov] [Text] [Moscow PRAVDA in Russian 13 Apr 81 p 8] 11004

NEW TANKER REFERENCE--It has already been a dozen and a half years since the American tanker "Torrey Canyon" struck cliffs on the British coast due to malfunction of its only radar station; this incident has not been forgotten, and even the name of the vessel has become a term commonly used to mean something disastrous. The 120,000 tons of petroleum that were spilled into the sea elicited catastrophic consequences. This is why questions associated with design support to safe operation of such vessels are acquiring priority significance in the planning of large tankers. This problem is one of the most important ones examined in the book "Sovremennyye tankery" [Modern Tankers], which was just printed by the "Sudostroyeniye" Publishing House. The author of the book, engineer N. N. Rodionov, is well known in Soviet ship building. Nikolay Nikolayevich was the chief designer for the plan of the first large Soviet tankers of the "Krym" class, developed by the Central Design Office of "Baltsudoproyekt". Rodionov had participated in the planning of tankers earlier in different capacities as well. This is why it is natural for his name to appear on the cover of such a book. He examines the complex of problems that are solved in the planning of large ships intended to carry liquid cargo, and he analyzes the basic trends in development of petroleum shipping and large ship building. The pages of the book are saturated with concern for preventing pollution of the seas by tankers. A number of measures insuring operational safety were foreseen in the plan for vessels of the "Krym" class. These measures were reflected to an even greater extent in the plan for new Soviet tankers of the "Pobeda" class. Despite the fact that the book is intended for engineers and technicians involved in the planning, construction, and operation of tankers, a broader reading public will welcome it with interest. [By Yu. Stvolinskiy] [Text] [Leningrad LENINGRADSKAYA PRAVDA in Russian 4 Mar 81 p 4] 11004

TURKMEN OIL DEPOSIT--The Koturdepe petroleum deposit in Central Asia has received a new life. An automated complex to intensify fuel extraction has gone to work there. The system composed of powerful pumping plants and pipelines pumps up to 5,000 cubic meters of water each day into the old wells. This maintains layer pressure at a stable level. The rich experience of specialists from Tyumen', Bashkiria, Kazakhstan, and Azerbaijan was used to revive the old petroleum fields of Turkmenistan. This cooperation helped bring back many old deposits which seemed to have exhausted their resources. "The 26th CPSU Congress spoke of the need to improve the extraction of petroleum by using progressive techniques of influencing the layers," said V. Petrov, chief of the Turkmenneft' [Turkmen Petroleum] Association. "Turkmenistan already has 100 old wells working in the new regime, and we have received thousands of tons of additional petroleum. The work to restore old wells will be continued. Complexes to intensify petroleum extraction will be built at all the deposits of the republic." [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Mar 81 p1] 11176

OFFSHORE WELL TECHNOLOGY--Underwater wells whose wellheads are located on the sea floor have special units for remote control of the well valves. A source of energy is required to operate these valves. The energy of the layer into which the well bores is the most inexpensive source. The power supply unit to control an underwater well using by-product gas consists of high and low pressure hydropneumatic storage batteries. But they also have their problems. They contain a large number of batteries and complex automatic regulators, which lowers working reliability. Moreover, there is no monitoring of pressure in the batteries and they are charged only when a pressure valve is closed. Specialists at the Scientific Research and Design Institute of Full Automation of the Petroleum and Chemical Industry have developed a new power supply unit which overcomes these problems. The innovation makes it possible to use layer energy and significantly improve the reliability of the underwater well control system. [Text] [Baku VYSHKA in Russian 10 Mar 81 p 3] 11176

GAS PIPELINE DEVELOPED--Volgograd--The Kalacheyevskiy gas compressor plant of the Volgograd sector of the Urengoy--Chelyabinsk--Petrovsk--Novopskov gas pipeline has launched three powerful new units in operation. The plant is located in Voronezhskaya Oblast. The new units increased the amount of gas pumped by 35-40 million cubic meters a day. In the first quarter of this year new power units will also be received at the Pisarevskaya and Bubnovskaya compressor plants. This will increase the delivery of gas to enterprises of the Donets basin and the South even further. The Volgogradtransgaz [Volgograd Gas Transportation] Production Association has reached the figure of 250-260 million cubic meters of gas a day. Complete introduction of the Urengoy--Chelyabinsk--Petrovsk--Novopskov line will increase the capacity by another 14 billion cubic meters a year. The decision has now been made to construct a second line of the pipeline in the Volgograd sector. [Text] [Moscow IZVESTIYA in Russian 4 Feb 81 p 1] 11176

GROZNYY--BAKU PIPELINE--Baku--Specialists from the Yuzhgiproneftеprovod [possibly Southern State Planning Institute for Petroleum Pipelines] Institute in Kiev have completed the first detail designs for construction of the Groznyy--Baku trunk petroleum pipeline. This 621-kilometer petroleum "meridion" of the Caucasus will insure steady, continuous supplies of crude petroleum to the refineries of the fraternal Caucasian republics. The plan of this manmade river of oil includes automation and remote control equipment, effective corrosion protection for the pipe, and measures to protect the environment. The rugged country which the line must cross, with dozens of large and small rivers, mountains, and highways, demanded that specialists find fundamentally new concepts. On the threshhold of the 26th CPSU Congress the construction workers are putting the first kilometers of pipe of the new line into the trenches. Construction of the pipeline is to be completed in record time. [Text] [Moscow IZVESTIYA in Russian 4 Feb 81 p 1] 11176

NEW SIBERIAN OIL WELL--Surgut, 8 Nov--The oil workers of the Middle Ob' region have launched a new deposit in operation, the Karamovskoye deposit. The first 3,000 tons of black gold will come this year from a depth of almost three kilometers. In the future the flow of oil from the deposit will increase greatly. The Karamovskoye is the tenth deposit at which the workers of the Surgutneftgaz [Surgut Petroleum and Gas] Association have been employed. Construction and work preparatory to drilling has been started at the Muravlenkovskoye and Sutorminskoye deposits. The East Surugt and Kogolymskoye deposits will also be brought into operation. [Text] [Moscow PRAVDA in Russian 9 Nov 80 p 6] 11176

MURABEK GAS REFINERY--Murabek--The installations of the third phase of one of the country's largest gas refineries, in Murabek, have begun operations. The workers fulfilled their socialist obligations by turning the project over for launching three months ahead of schedule. The sulfurous gas from deposits in southern Uzbekistan, cleaned in gigantic installations, has been put into the trunk pipelines running to the republics of Central Asia and a number of regions of the RSFSR. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Mar 81 p 1] 11176

MINE WORK UPGRADED--Deputy USSR minister of coal industry Ye. Rozhchenko reports that the article "Without a Backlog," published by SOTSIALISTICHESKAYA INDUSTRIYA on 14 January 1981 was correct in pointing to shortcomings in the work of the Baydayevskaya mine. The number of shaft cutting workers will be increased by 190 to improve the work of the enterprise in conducting preparatory excavations and timely preparation of the mining face. This will make it possible to do an additional four kilometers of preliminary excavation this year, compared to last year. Two high-speed shaft-cutting brigades have been formed and will provide half of the annual volume of preparatory excavations. These collectives are working on the brigade contract system. Payment by the job is used for installation work. In addition, another group of workers is being sent to the mine from the installation-dismantling administration of the Yuzhkuzbassugol' [Southern Kuznets Basin Coal] Association. They will help set up the equipment of the preparatory and working faces faster. The mine has organized a special group of highly skilled machine operators who will work on modernization of shaft-cutting equipment and mechanization of manual labor. Socialist competition has been organized among shaft-cutting sections and brigades. In the first half of 1981 schools of progressive know-how are to be conducted at the Nagornaya and imeni Lenin mines. The mine engineering service has been strengthened. S. Isakov, winner of the USSR State Prize who formerly worked as chief of a shaft-cutting section at the Nagornaya mine, has been appointed to the position of chief engineer. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Mar 81 p 2] 11176

TYUMEN' OIL EXTRACTION TOTALS--Since the beginning of the year, Tyumen oilfields have extracted half a million tons more oil than required by the plans. The collective of Glavtyumenneftegaz intends to exceed the target by an additional 2 million tons of petroleum before the end of the year. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 4] 11004

NEW COAL MINES--The last shaft of "Yuzhnodonbasskaya " Mine No 3, presently under construction, has been dug. The output capacity of this enterprise is 2.4 million tons of coal per year. Fourteen large mines are to be placed into operation during the 11th Five-Year Plan in the country's oldest coal basin. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 4] 11004

CAUCASIAN POWERLINE--Erection of the LEP-500 power transmission line through the most difficult section of the main Caucasian range--Nakharskiy Pass--has been finished. It will provide energy of the Ingurskaya GES to cities and towns of the Northern Caucasus. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 4] 11004

HIGH PRODUCTIVITY ROTARY EXCAVATOR--One train of coal per hour--such is the productivity of rotary complexes of a new class, the production of which has been readied by the "Zhdanovtyazhmash" Association. The excavator is intended for work in open-pit mines of the "Krasnoyarskugol'" Association. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 14, Apr 81 p 4] 11004

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